

Report on
2nd ICG-CGCRI Tutorial 2021
on
Glass Science & Technology
Through On-line Mode

18-23 and 25-27 January 2021 (09 days)



Organised by
CSIR-Central Glass and Ceramic Research Institute
in association with
International Commission on Glass



CSIR-CENTRAL GLASS & CERAMIC RESEARCH INSTITUTE
196 Raja S. C. Mullick Road, Kolkata – 700032, India
February 2021

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**CSIR – Central Glass and Ceramic Research Institute
Kolkata, India**

February 2021

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Preamble:

CSIR-Central Glass & Ceramic Research Institute [CSIR-CGCRI], Kolkata, India in association with the International Commission on Glass (ICG) jointly organized the 2nd ICG-CGCRI Tutorial 2021 in online mode during January 18-27, 2021. The tutorial covered various aspects of glass science and technology including basics of glass/glass-ceramics and glass melts, structural aspects of glass, advanced characterization techniques, properties of glasses and glass-ceramics for advanced applications. For the benefit of the budding glass researches across the globe, ICG hosts its winter and summer schools every alternative year in Wuhan, China and Montpellier, France. Keeping in mind The Indian glass community, especially young glass researchers industry personnel, CGCRI, Kolkata organized such ICG-CGCRI Tutorial event first in 2017 which received an overwhelming appreciation. This Tutorial is supported by the ICG education team consisting of entire galaxy of stalwart faculties from across the globe who not only designed the course curriculum, but also taught, inspired and mentored the students during their entire course work. It was envisaged that the tutorial will aid towards enrichment of knowledge base of glass researchers and promote development of skilled human resource in the field of glass science and technology for catering to the needs of the country.

This was a unique opportunity for the students, young researchers, faculties and glass industry representatives. We selected about 70 students for this school from across the globe. In this tutorial 23 topics were covered by 15 eminent speakers from various countries like USA, UK, France, Germany, Japan and Brazil. The online tutorial on glass was conducted successfully for the first time in India which has been reflected in the awe-inspiring feedback received from the participants, faculties, scientists and industrialists.

Foreword



It is our pleasure and privilege to take part in organizing the "2nd ICG-CGCRI Tutorial 2021" on glass during January 18-27, 2021 in CSIR-CGCRI, Kolkata, India conducted online. It was just a pleasant coincidence that I took over the charge as Director of the prestigious Institute CSIR-CGCRI on 18th January itself and attended the program. It is particularly remarkable that the Tutorial is conducted for the 2nd time in India in association with International Commission on Glass (ICG) despite colossal difficulties caused by the most devastating Covid19 pandemic. The first such tutorial was conducted in India in 2017 by considering the needs of the country for development of skilled human resources in the field of glass science and technology. CSIR-CGCRI has committed to conduct such events once in every four years in association with ICG.

The major objectives of this Institute is to carry out basic and applied research in the fields of glass, ceramics, refractories, vitreous enamels, composites for various diverse applications and develop the technologies relevant to the country's security, economic, industrial and socio-economic needs. It caters to many sectors by world class research and development of technologies to name a few are Energy, Power, Petroleum, Electronics, communication, Bio-medical, refractory, steel, aluminum & other related metal industries and strategic. It has excellence in different varied glasses, ceramic materials, optics and fiber optics materials and devices, energy material such as SOFC, LI & Na ion batteries, SOEC, Sensors, Bio medical devices, bio-sensors and implants, radiation shielding, cutting tool, laser glasses, advanced refractories for steel and other industries, waste to wealth generation and many advanced applications.

CSIR-CGCRI undertake advanced R&D projects which are internationally competitive and public-private partnership projects sponsored by private/public sector enterprises. It also provide technical advisory and infra-structural services like project engineering, testing & evaluation, training & education and dissemination of scientific information to the public domain.

CSIR-CGCRI, established in 1950, has a legacy of more than 70 years with successful implementation of major programs and the development of novel products and processes. Specialty glass is one such area in which this Institute has left its remarkable footprint.

Glass is emerging as the material of choice from the point of advanced applications such as buildings, many electronic gadgets, shatter-proof

touch screens for mobiles and other display devices. High purity silica glass enabled optical communication to be realized through glass fibers and making a revolution in telecommunication. The examples are endless but each one highlights the diverse characteristics developed in glass to meet the needs of society.

Glass is one of the very few materials that can be customized for superior performance and diverse applications. It is thus an appropriate forum to bring together the budding glass students/researchers/ industry personals along with the pioneers and torch bearers of the field of glass research so that an amalgamation of minds can take place. I take this opportunity to thank and record my gratitude to all colleagues of CSIR-CGCRI, the eminent speakers and participants from across the globe who made the contributions, which made 2nd ICG-CGCRI a very successful event. I am also thankful for the inspiring feedbacks and appreciations received from the participants, faculties, scientists and industrialists. I look forward to the organization of ICG2025 Congress and 3rd ICG-CGCRI Tutorial 2025.



(Dr. Suman Kumari Mishra)
Director, CSIR-CGCRI and
Chairperson, 2nd ICG-CGCRI Tutorial 2021

Organizing Committee

Director, CSIR-CGCRI	Chairman
Shri Sitendu Mandal Chief Scientist and Head, Specialty Glass Division (SGD)	Organizing Secretary
Tutorial Core Secretariat: Dr. Atiar Rahaman Molla , Principal Scientist Organizing Joint Secretary (I) (Technical and Secretariat) Dr. Kaushik Biswas , Principal Scientist Organizing Joint Secretary (II) (Technical and Secretariat)	
Dr. K. Annapurna Sr. Principal Scientist In-charge: Virtual Mode Arrangement and Students’ Projects Assisting Members: Dr. Anal Tarafder Principal Scientist Dr. Sourja Ghosh Principal Scientist, Dr. Debashri Ghosh Senior Scientist, Dr. Shirshendu Chakraborty Senior Scientist Shri Srikrishna Manna Senior Technical Officer (2) Mr. Agniv Adhikary Senior Technical Officer (1) Ms Ruma Chakraborty Senior Technical Officer (1)	Shri Santanu Sen Sr. Principal Scientist and Head, Instrumentation Section, MCID: In-charge: Instrumentation Facilities and General Arrangement Assisting Members: Shri M L Ram Senior Technical Officer (3) Shri Mrinmoy Adhikary Technical Officer Shri Shibasish Barik Technical Officer Shri Gautam Ghosh Sr. Technician (2)
Dr. Sunirmal Jana Sr. Principal Scientist In-charge: Finance Management and Day to Day Event Management Assisting Members: Mrs. Mousumi Majumdar, Sr. Principal Scientist Dr. P. K. Sinha, Sr. Principal Scientist Mr. Rana Dasgupta, Principal Technical Officer Mr. Priyam Mukherjee, S.O (F & A) Ms. Subarna Roy, ASO (G), Finance and Accounts	

Dr. Debashis Bandyopadhyay

Sr. Principal Scientist and Head, ISTAG
In-charge: Liaison with CSIR and Electronic Media

Assisting Members:

Dr. N. C. Pramanik, Sr, Principal Scientist

Dr. Indranil Biswas, Pr. Scientist

Dr. Ambarish Sanyal, Sr. Scientist

Mr. Debshis Sarkar, Senior Technical Officer (2)

Mrs. Krishna Bhattacharya, Senior Hindi Officer, Hindi Cell

Dr. Ashis K. Mandal

Principal Scientist
In-charge: Tutorial Registration
and Logistics

Assisting Members:

Dr. Sumana Ghosh
Pr. Scientist

Dr. Anirban Dhar
Sr. Scientist

Dr. Himanshu S. Maharana
Scientist

Mr. Sanjib Samaddar
Senior Technical Officer (2)

Dr. Sunirmal Jana

Sr. Principal Scientist
In-charge: Tutorial Website
Designing and E-Brochure
Committee

Assisting Members:

Mr. Agniv Adhikary
Senior Technical Officer (1)

Dr. S. Balaji
Principal Scientist

Dr. Kausik Dana
Pr. Scientist

Dr. Atasi Pal
Pr. Scientist

Dr. Ambarish Sanyal
Sr. Scientist

Dr. Srabane Sen
Pr. Scientist

Mr. Sukamal Mondal
Pr. Tech. Officer

Mr. Sirshendu Ghorui
Sr. Tech. Officer

Mrs. Sanhita Ganguly
S.O (G)

Dr. Ranjan Sen

Chief Scientist (Rtd.)
Advisor, Tutorial Organizing Committee

Statistics on 2nd ICG-CGCRI Tutorial 2021

	Total	Indian	Foreign
Participants	68	64	4
Faculties	15	Nil	15
Total topics covered	23		
Session Chairs	15	15	Nil
Projects Allotted	11		
Projects awarded with certificates	4		

Topics covered

Day 1	18 th January 2021 (Monday)			
Session Chair: Dr. Sunirmal Jana Senior Principal Scientist, CSIR-CGCRI				
	Topics	Instructor	Country and Affiliation	Date and Time (IST)
1	Phase equilibria and chemical activities in glassmelts	Prof. R. Conradt	UniglassAC GmbH, Aachen, Germany	18.01.2021 7:20-8:20 PM
Day 2	19 th January 2021 (Tuesday)			
Session Chair: Prof. Dipankar Banerjee Indian Institute of Science, Bengaluru and Chairman, Research Council, CSIR-CGCRI				
1	Evolution of theories on glass structure	Alicia Duran	CSIC, Spain	19.01.2021 5:00-6:00 PM
Session Chair: Dr. K. Muraleedharan Former Director, CSIR-CGCRI and Emeritus Scientist, C-MET, Thrissur				
2	Thermodynamics and energy demands for batch to melt conversion	Prof. R. Conradt	UniglassAC GmbH, Aachen, Germany	19.01.2021 6:10-7:10 PM

Session Chair: Dr. G. P. Kothiyal Formerly Head, Glass and Advanced Ceramics Division, Materials Group BARC, Mumbai				
3	Heat Transfer Phenomena in Glass Melting Processes	Prof. M. K. Choudhary	MKC Innovations LLC and The Ohio State University, USA	19.01.2020 7:20-8:20 PM
Day 3	20 th January 2021 (Wednesday)			
Session Chair: Dr. Mukul Pal Senior Principal Scientist, CSIR-CGCRI				
1	Chemical Durability of Glass	Prof. R. Conradt	UniglassAC GmbH, Aachen, Germany	20.01.2021 3:50-4:50 PM
Session Chair: Dr. K. Annapurna Senior Principal Scientist, CSIR-CGCRI				
2	Optical Properties of Glass; Glass color and redox chemistry (I)	Prof. J. M. Parker	Sheffield University, Sheffield, U.K.	20.01.2021 5:00-6:00 PM
3	Optical Properties of Glass; Glass color and redox chemistry (II)	Prof. J. M. Parker	Sheffield University, Sheffield, U.K.	20.01.2021 6:10-7:10 PM
Session Chair: Mr. V. Ramaswamy MD, Borosil Glass Works Ltd., Mumbai				
4	Futuristic glasses	Prof. John C. Mauro	PSU, USA	20.01.2021 7:20-8:20 PM
Day 4	21 st January 2021 (Thursday)			
Session Chair: Dr. Gautam Kr. Dey BARC				
1	Neutron and X- ray diffraction studies of glass	Prof. R. Vacher	University of Montpellier, France	21.01.2021 5:00-6:00 PM
2	Vibrations (I): basics of IR absorption, Brillouin and Raman scattering.	Prof. B. Hehlen	University of Montpellier, France	21.01.2021 6:10-7:10 PM
3	Vibrations (II): relation with glass structure & properties	Prof. B. Hehlen	University of Montpellier, France	21.01.2021 7:20-8:20 PM

Day 5	22 nd January 2021 (Friday)			
Session Chair: Prof. Aswini K. Ghosh Indian Association for the Cultivation of Science, Kolkata				
1	NMR technique for evaluation of glass structure (I)	Prof. P. Florian	CEMHTI-CNRS, France	22.01.2021 3:50-4:50 PM
2	NMR technique for evaluation of glass structure (II)	Prof. P. Florian	CEMHTI-CNRS, France	22.01.2021 5:00-6:00 PM
Session Chair: Prof. K. K. Ray IIT Kharagpur				
3	Mechanical properties of glass	Prof. A. Varshneya	Saxon Glass Technologies, Alfred, USA	22.01.2021 6:10-7:10 PM
4	Glass Strengthening Techniques	Prof. A. Varshneya	Saxon Glass Technologies, Alfred, USA	22.01.2021 7:20-8:20 PM
Day 6	25 th January 2021 (Monday)			
Session Chair: Dr. C. P. Kaushik Director, Nuclear Recycle Group (NRG), BARC				
1	Nuclear waste vitrification and chemical durability	Prof. R. J. Hand	Sheffield University, UK	25.01.2021 3:00-4:50 PM
Session Chair: Dr. Dipayan Sanyal Chief Scientist and Chairman, ICG-CGCRI Tutorial, CSIR-CGCRI				
2	Modelling (I): Atomistic Simulations	Prof. Akira Takada	Asahi Glass Yokohama, Japan	25.01.2021 5:00-6:00 PM
Session Chair : Dr. Ranjan Sen Former Chief Scientist, CSIR-CGCRI				
3	Glass-Ceramics (I): Fundamentals of Nucleation and crystallization	Prof. E. D. Zanotto	Federal University of São Carlos, São Carlos, Brazil	25.01.2021 6:10-7:10 PM
4	Glass-Ceramics (II): Advanced Applications	Prof. E. D. Zanotto	Federal University of São Carlos, São Carlos, Brazil	25.01.2021 7:20-8:20 PM

Day 7	26 th January 2021 (Tuesday)			
Session Chair: Dr. Shyamal Kr. Bhadra Former Chief Scientist, CSIR-CGCRI				
1	Rare-earth doped glasses for photonic applications	Prof. S. Tanabe	Kyoto University, Japan	26.01.2021 3:50-4:50 PM
2	Modelling (II): Relation with structure and properties	Prof. Akira Takada	Asahi Glass Yokohama, Japan	26.01.2021 5:00-6:00 PM
Session Chair: Dr. A. R. Molla Principal Scientist, CSIR-CGCRI				
3	Bioactive glass and glass-ceramic	A. R. Boccaccini	University of Erlangen-Nuremberg, Germany.	26.01.2021 6:10-7:10 PM
4	Ionic conductivity in Glasses	Ana C. M Rodrigues	Federal University of São Carlos, São Carlos, Brazil	26.01.2021 7:20-8:20 PM

About 2nd ICG-CGCRI Tutorial 2021

The International Commission on Glass (ICG) and CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata, India jointly organized the 2nd ICG-CGCRI Tutorial 2021 on Glass in virtual mode through MS Teams during January 18 – 27, 2021. This tutorial aimed to cover a wide spectrum of topics related to glass science and technology including fundamentals of thermodynamics, melt flow dynamics, mechanical behaviour, characterisation techniques, nucleation kinetics, atomistic simulation and so on for developing an insight into the processing-structure-property correlations of glass and glass-ceramics for the benefit of the budding glass researchers across the globe. The first ever ICG-CGCRI Tutorial that was organized by CSIR-CGCRI, Kolkata in 2017 was very successful and had generated an overwhelming response. With this background, ICG granted permission to CSIR-CGCRI to conduct such tutorials once in every four years. The website for the Tutorial (www.icg-cgcri-tutorial2021.com) was launched on 1st December 2020 in virtual mode by Prof. Reinhard Conradt, Vice-President, ICG who delivered his Presidential address to the audience. Dr. K Muraleedharan, Former Director of CSIR-CGCRI and Shri Ashim Kumar Chakraborty, Former Chief Scientist and Director (Acting) of CSIR-CGCRI, Prof. J. M. Parker (Sheffield University, Sheffield, UK), Shri Sitendu Mandal (Chief scientist & Organizing Secretary), and other distinguished dignitaries from Glass community also participated in the website-launching program.

On 18th January, 2021, the 2nd ICG-CGCRI Tutorial 2021 was formally inaugurated by Dr. Suman Kumari Mishra, Director, CSIR-CGCRI in presence of Dr. Dipayan Sanyal, Chief Scientist, CSIR-CGCRI, Prof. Alicia Duran, President, ICG, Prof. R Conradt, Vice President, ICG, Prof. J. M. Parker, Advisor, ICG-Education, Prof. Ana C. M. Rodrigues, Chairperson, TC-23 (ICG-Education) and several other eminent academicians and expert professionals from glass science & technology community. Prof. Dipankar Banerjee, Chairman, Research Council, CSIR-CGCRI and Prof. Alicia Duran, President, ICG graced the event as Chief Guest and the Guest of Honor respectively.

Shri Sitendu Mandal, Chief Scientist and Organizing Secretary of 2nd ICG-CGCRI Tutorial 2021 delivered the formal vote of thanks to all the dignitaries, guests, participants and other members of this tutorial including the local organizing committee members for their wholehearted support, active participation in making this inauguration a grand success.

A total of 23 lectures were delivered during the 9-days tutorial by stalwarts like, Prof. R. Conradt (Uniglass AC GmbH, Aachen, Germany); Prof. J. M. Parker (Sheffield University, Sheffield, U.K); Prof. Alicia Duran (CSIC, Spain); Prof. M K Choudhary (MKC Innovations LLC and The Ohio State University, USA); Prof. John Mauro (PSU, USA); Prof. R. Vacher and Prof. B. Hehlen (University of Montpellier, France); Prof. P. Florian (CEMHTI-CNRS, France); Prof. A. Varshneya (Saxon Glass Technologies, Alfred, USA); Prof. R. J. Hand (Sheffield University, UK); Prof. Akira Takada (Asahi Glass, Yokohama, Japan); Prof. E. D. Zanotto (Federal University of



Dr. Suman Kumari Mishra, Director, CSIR-CGCRI inaugurating the 2nd ICG-CGCRI Tutorial 2021



Shri Sitendu Mandal, Chief Scientist, CSIR-CGCRI and Organizing Secretary of 2nd ICG-CGCRI Tutorial 2021 delivering the vote of thanks

São Carlos, São Carlos, Brazil); Prof. S. Tanabe (Kyoto University, Japan); Prof. A. R. Boccaccini (University of Erlangen-Nuremberg, Germany); Prof. Ana C. M. Rodrigues (Federal University of São Carlos, Brazil) and other distinguished experts from R&D Institutes, academia and Industries. The topics covered in this tutorial are on the various aspects of glasses including fundamentals of glass, thermodynamics, energy demands and heat-transport phenomena of glass melts/glass formers, the structural aspects of glasses/glass-ceramics, bioactive glass and glass-ceramics, redox chemistry of glasses including conducting glasses, advanced testing and characterization techniques to evaluate various properties of glasses, glass-ceramics and other glass based composites, the futuristic glasses, etc. All 23 lectures were covered in 15 different sessions, which were chaired by eminent scientists & researchers from India.

In addition, 11 students' projects were also allocated to eleven groups, formed out of the participants to explore the new horizon of glass sciences and to address vital issues in connection with glass science and technology.

The participants carried out the project work very meticulously and many new ideas emerged for future technologies related to application of glass in frontier areas. The students were asked to carry out the project work in a group to develop mutual understanding and collaborative spirits among the participants. Almost all the groups presented their work very nicely which were evaluated by an eight membered jury consisting of eminent personalities from India and abroad.

Prof. J. M. Parker, Adviser, ICG- Education and Dr. K. Annapurna, Sr. Pr. Scientist, Specialty Glass Division, CSIR-CGCRI, India announced the projects which bagged awards for the 1st, 2nd and 3rd prizes. The 1st prize was awarded for the project work on "In spite of the many advantages glass has as a solid-state electrolyte in Li batteries, no breakthrough for practical applications has been seen. Identify its limitations and design glass composition(s) to overcome those limitations."

The 2nd prize was jointly awarded to two project teams who had worked on “Foam glass is a high quality, insulation material. A proposal has been made to improve its properties by creating vacuum bubbles rather than gas filled bubbles. Consider the practicalities of this suggestion” and project work on “You work in the QA department of your firm, which produces optical components based on a range of glassy materials. List in order of important what parameters you would monitor, how you would measure them and indicate for each what range of values would be acceptable”

The 3rd prize went to the project team for their work on “Write an article for Wikipedia on the use of glass in the human body.”

The 9-days long tutorial program concluded with Panel Discussion and Valedictory Session. The panelists were Dr. (Mrs.) Suman Kumari Mishra (Director, CSIR-CGCRI, Kolkata, India); Dr. Manoj K. Choudhary (Former President, International Commission on Glass (ICG)); Mr. Pradip Kumar Kheruka (CMD, M/s Borosil Glass Works Ltd., Mumbai, India); and Prof. Arun Kumar Varhneya, President, Saxon Glass, USA. Mr. Sitendu Mandal (Chief Scientist and Organizing Secretary, ICG-CGCRI Tutorial, CSIR-CGCRI, Kolkata, India) welcomed the entire panelists for their gracious presence. Dr. A. R. Molla, Organizing Joint Secretary, ICG-CGCRI Tutorial, CSIR-CGCRI, Kolkata, India moderated the session. Panelists discussed about the proceeding that happened during the past 9-days and also about the future prospects of glass technology and the career opportunities for glass researchers.

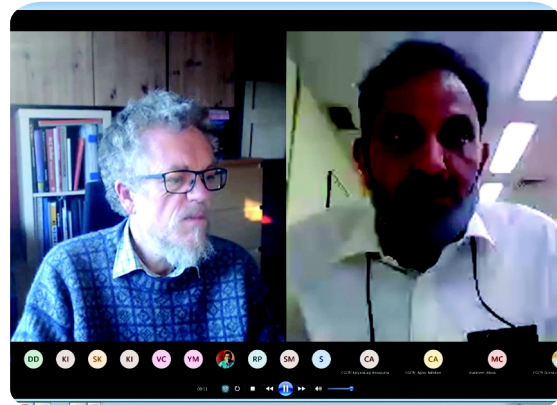
Dr. (Mrs.) Suman K Mishra made the introductory remarks, and talked about the career opportunity. She stated that glass and ceramic researchers have huge scope and very excellent career opportunities across the globe for development of new materials for catering to the demands of the society. Even they have huge demand in society/community and specialized one if interested can go for entrepreneurship for various end applications of glasses including the areas like biomedical, building/structural, coatings on glasses for various functionalities and so on.

Dr. Manoj Choudhary talked on career prospects/opportunities for researchers working on glass science & technologies and pointed out that there are grand challenges in global aspect. He also remarked that glasses have opportunities in all sectors like environment, energy, safety etc. Accordingly participants & students have to tap the opportunities and collaborate with various stakeholders. Various glasses are becoming highly demanding such as ultra thin glass used for display system is expected to be 30 b\$ by 2025, commodity glass (e-glass) 7.8%, construction 6.15% (66.7 b\$), solar energy 20.5% per year.

Mr. Pradeep Kheruka commented that scientists are developing new products which are of very high interest and on the other hand, the persons working in glass production are mostly people with less qualifications but possessing hands on experience in the process and highly skilled to produce tons of glasses of various types. He mentioned

Glimpses of Various Lecture Sessions

Ionic Conductivity in Glasses
 Ana Candida M. Rodrigues
 Federal University of São Carlos
 Department of Materials Science
 LaMaV
 The Center for Research, Technology and Education in Vitreous Materials CeRTEV



Why use glass?

- Glass is just beautiful....
- Transparency, luster, and durability
- Glass is recyclable
- Glass protects!
 Tanuj Samaddar (15 yr old)
 AIGMF entry Sept. 2020

Solid-State NMR
 Part 1 : Basics Concepts

P. Florian
 CEMHTI-CNRS, Orléans, France

The Glass Age: Transportation and Architecture

- Automotive Interiors and Glazing
- Energy-Efficient Glazing
- Modern Design & Functionality
- Acoustic Damping Glass
- Internet of Things



Student demonstration of glass formation and T_g inspired by a capoeira tune

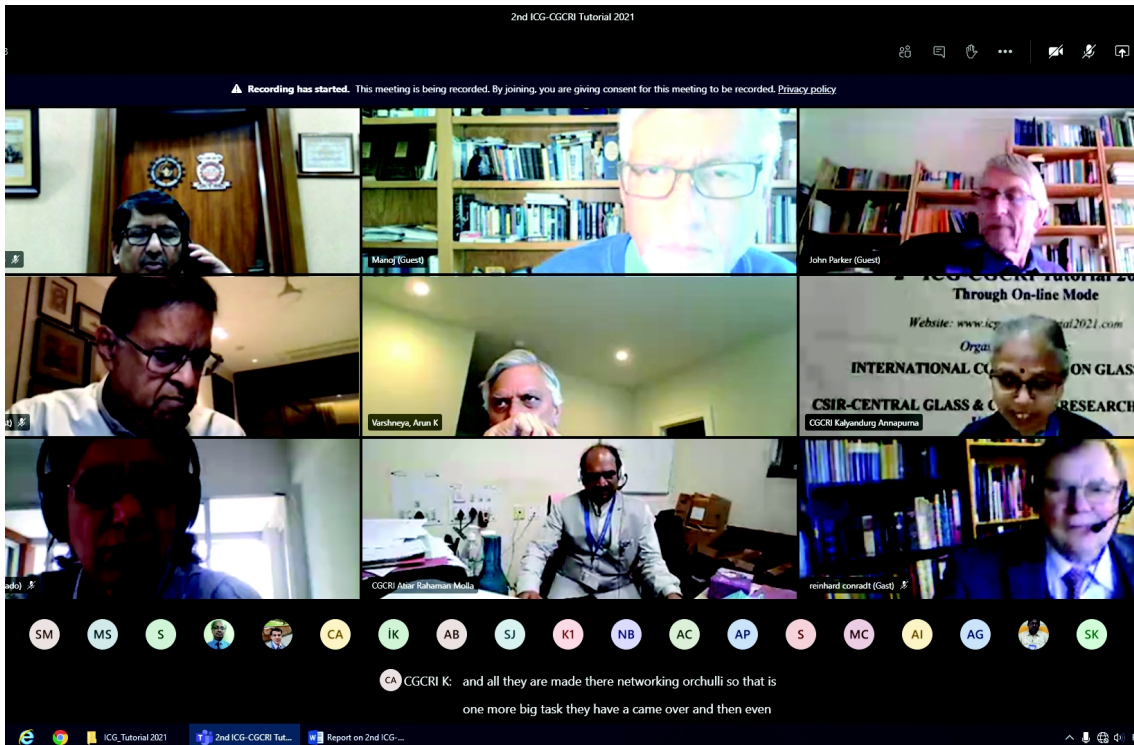
The LaMaV group

1. Introduction

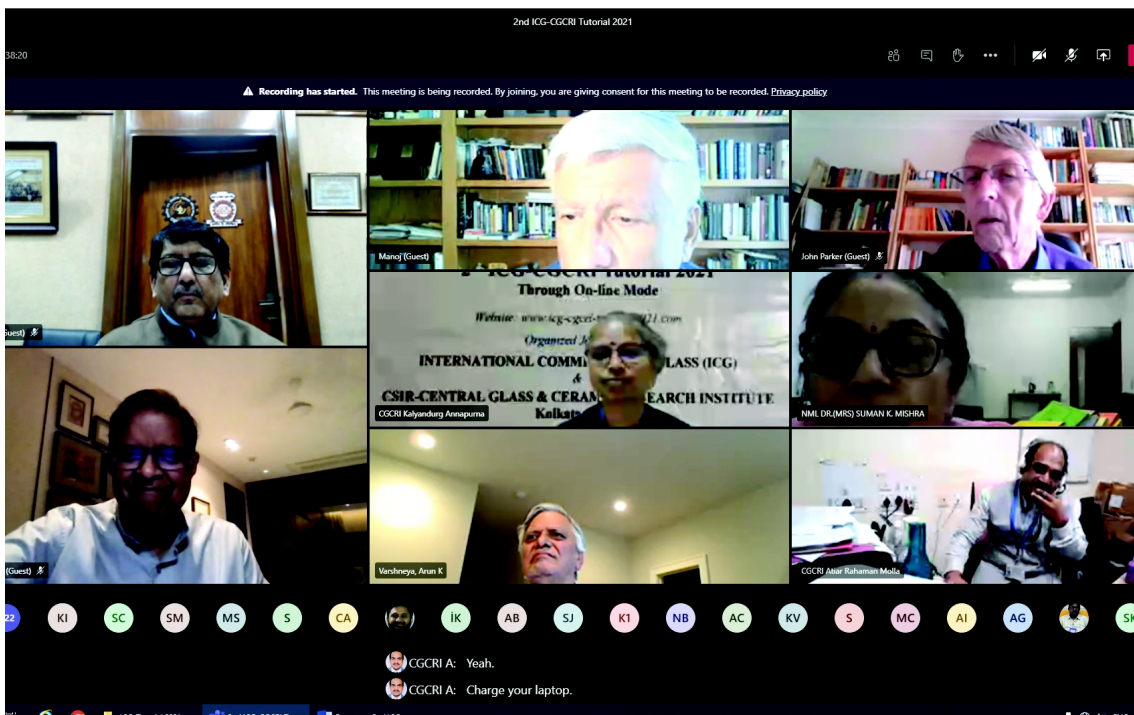
Important points to keep in mind for atomistic simulation:
 "To not see the wood for the trees" (proverb)
 = to be caught up with trivial matters and lose sight of the big picture

macroscopic world which we see in our daily life
 micrometer-centimeter, second-year with a variety of disturbances

microscopic world observed
 angstrom-nanometer, picosecond-nanosecond in idealized environments



Announcement of project awards by Prof. J. M. Parker and Dr. K. Annapurna



Panel Discussion

that his company has at least about 30 problems which researchers or academicians can take up for finding solutions.

In the panel discussion various important issues were discussed and Mr. Kheruka stressed on the need for deep involvement of researchers and academicians to solve problems faced by the glass industries. Dr. Mishra took up this challenge of looking into some of their problems by CGCRI, that to be followed up after this event.

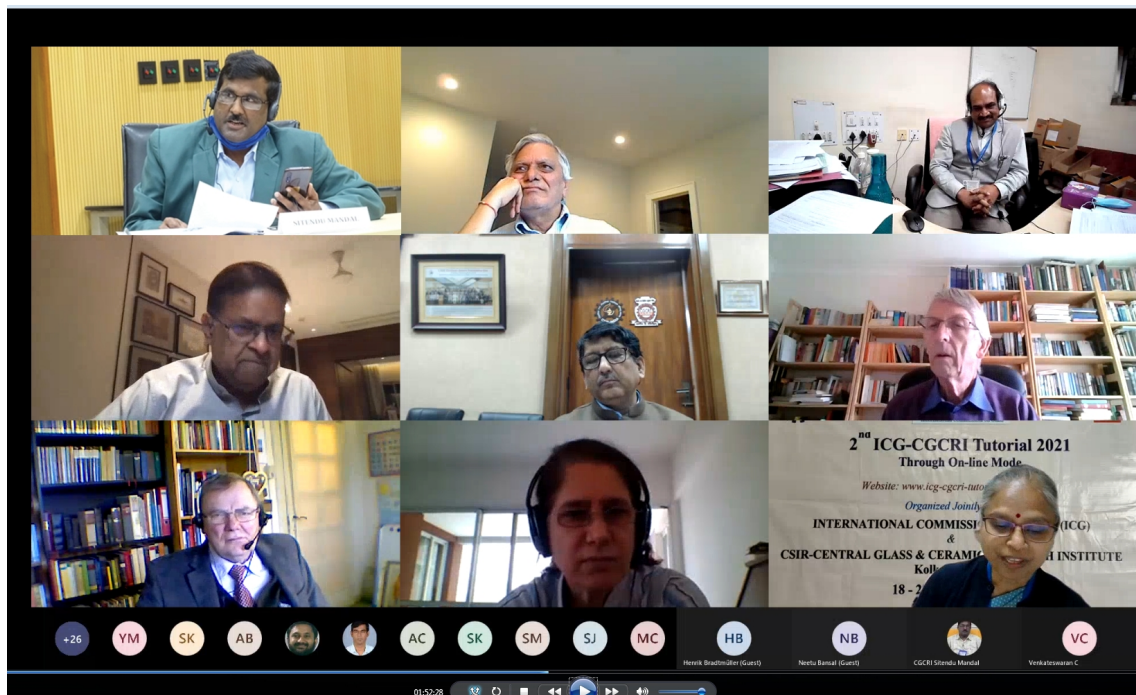
Prof. A. Varshneya spoke about the life saving applications of glasses like the one his company Saxon Glass is producing and such glasses can be developed in India and commercially produced. These deliberations were followed by question from participants.

All the speakers and participants highly appreciated for conducting such tutorial in online mode during the grievous pandemic Covid 19.

The tutorial was formally concluded by a Valedictory Session through insightful deliberations of Dr. Dipayan Sanyal, Prof. Manoj Choudhary, Prof. Conradt, Prof. Parker, Prof. Rodrigues, Prof. E. D. Zanotto, Prof. Arun Varshneya, etc. All the dignitaries commended the efforts made by CSIR-CGCRI and congratulated for its grand success. Mr. Sitendu Mandal, Organizing Secretary of this event thanked all the participants, speakers for their support and deliberations.

Finally, formal vote of thanks to all dignitaries, participants and others, was offered by Dr. A. R. Molla, Organizing Joint Secretary, ICG-CGCRI Tutorial.

Mr. Sitendu Mandal, Chief Scientist and Organizing Secretary, ICG-CGCRI Tutorial, CSIR-CGCRI, Kolkata, India announced the formal closure of this tutorial with an expectation to have great International Congress on Glass (ICG-2025), to be held in 2025 in Kolkata, India.



Valedictory Session

Key outcomes of the Tutorial:

CSIR-CGCRI took up this challenge for hosting a tutorial on glass in online mode in associations with the ICG for the first time. The website for the tutorial was launched on 1st December and only 20 days was given to the students for applying for registration for this tutorial. Under this tutorial various projects were planned to be allocated to different students' groups and so it was decided that maximum 60 students will be selected for this school for a proper grooming, mentoring and teaching. However, we received large number of applications within deadline and applications / requests kept pouring in even after the deadline. This clearly reflected how much students are interested to participate in the glass tutorial organized jointly by ICG and CGCRI, by paying registrations fees of Rs. 1000-2000 for Indians and US\$ 50 for foreign students. Unfortunately, we could not accept all the applications for maintaining quality of this glass school and finally 68 students were registered by considering their background. During the entire course work, the responses of the students were overwhelming and interactions with the students were lively. We had course instructors from various countries who are pioneers in their respective fields of glass research and teaching and that made the school much attractive to the students. This additionally opens up possibilities for the scientists of CGCRI to collaborate with some of these tutorial faculties in the areas of mutual interest.

This school created a unique platform for not only intensive interaction among the student participants across the globe but also to directly get taught, mentored and motivated by the stalwarts in the field.

We received feedbacks from the students and faculties post this tutorial event. Overall, these comments are highly motivating and inspiring. Some of the responses are provided as an example. CGCRI has decided to handpick few brilliant students from the list of participants to allow them to pursue their research career in the Institute to contribute for the nation as a whole.

Ms. Neetu Bansal from Thapar Institute of Engineering & Technology, Patiala was highly positive about this tutorial and she particularly liked “getting virtual face-to face with national and international glass scientists, learning the basics from the experts and working in a team with students from different places and institutions and sharing our knowledge”. Mr. Allan B. Samuel from Pondicherry University wrote that tutorial “Motivates me to continue my research in glass and glass ceramics. I was able to understand the research and career opportunities in this area and got a chance to hear and see eminent speakers in the field of glass and glass ceramics.” Henrik Bradtmüller from Universidade Federal de São Carlos (UFSCar), Brazil liked “very broad coverage of topics, the stimulating project work and networking and good relevance opportunities”. Mr. Sakthi Prasad a participant from CSIR-CGCRI wrote “It gives an opportunity to interact with research scholars from various institutes. It offers a stage to meet and interact with various pioneers in the field of glasses and it provides a platform to learn new topics in glasses”. It is not possible to share all the remarks made by the participants, however, overall responses were overwhelming.

Prof. E. D. Zanotto, LaMaV, DeMA, Federal University of Sao Carlos, Brazil said “This is only to thank you and your competent team for organizing such a wonderful tutorial!”

Dr. Manoj K. Choudhary, President, MKC Innovations, LLC. Adjunct Prof. Materials Science & Engineering, The Ohio State University and President, International Commission on Glass (2015-2018) appreciated the CGCRI effort by saying “CONGRATULATIONS on a superbly organized and conducted Tutorial! This was bound to happen and I was not surprised a bit!”

Renowned Professor and researcher of glass popularly known as “Glass Guru” Prof. Arun Varshneya, Professor of Glass Science & Engineering, Emeritus Alfred University and the President Saxon Glass Technologies, Inc. USA wrote “I would like to express my heartfelt Thank You for giving me an opportunity to “give back” to my Motherland by teaching glass engineering science to the younger generation mostly of India. Your organization of the Tutorial under the auspices of the ICG was near-

perfect. Minor glitches here and there were, as noted, only minor. More importantly, it was possible for you to collect a cadre of renowned teachers from all over the globe to deliver the glass tutorials to students (and some professionals) from across India. I am looking forward to January 2025 with the organization of the International Congress on Glass for the second time in India. It was a matter of pride for me to have helped with the organization of the first one, Delhi 1986”.

The online glass tutorial was organized successfully with seamless support from the IT team, the appreciation from the students and faculties are truly inspiring and motivating.



CSIR-Central Glass & Ceramic Research Institute

**196, Raja S.C. Mullick Road,
Kolkata – 700 032
West Bengal, India**

**EPABX: +91 33 2473 5829/3469/76/77/96
+91 33 24837340/41/42/43/44/45/46/49/50 (Extension)**

Fax/e-mail:

Director's Office: +91 33 2473 0957/dir_office@cgcri.res.in

Website: <https://www.cgcri.res.in/>