



CONFERENCE REPORT

SOL-GEL 2026

Mohammed Abdullah Alessa

Department of Physics, SUPA, University of Strathclyde, Glasgow, United Kingdom

Mohammed.alessa@strath.ac.uk

Introduction

The 23rd International Sol-Gel Conference was held in Lisbon, Portugal, from 31 August to 4 September 2026. Over 300 delegates attended the conference, including scientists, researchers, industry representatives and early-career professionals. The conference covered a wide range of sol-gel research topics, including the chemistry and fundamentals of the sol-gel process; structure and morphology control; hybrid and composite materials; energy applications; functional and protective coatings and thin films; and optical and optoelectronic applications. As my research involves preparing Ga_2O_3 -based thin films by chemical solution deposition (CSD), I was interested in topics related to thin films, metal oxide materials and sol-gel processing. During the conference, the programme included plenary and invited lectures, oral presentations and poster sessions covering different areas of sol-gel research. The poster sessions gave me the opportunity to explore a wider range of research, speak directly with presenters and learn about relevant work.

As part of the conference, I presented a poster entitled "Effects of deposition conditions on α - Ga_2O_3 thin films by chemical solution deposition". My work investigated how precursor solution concentration, spin-coating speed and the number of coating layers affected the properties of α - Ga_2O_3 thin films prepared by CSD. The results showed that these deposition conditions significantly affected the film thickness, morphology and optical properties. Presenting my work gave me the opportunity to explain my research to other researchers and discuss my findings with them. These discussions also allowed me to learn more about the sol-gel processing methods they used in related research.

Although there was limited work directly related to Ga_2O_3 , I found several other topics that were relevant to my research. Below, I have highlighted three talks and three posters that I found particularly interesting.

Title: Designing morphology and porosity in synthetic carbon materials via microwave-assisted sol-gel methodology.

Speaker: Elisa Martínez

Affiliation: Instituto de Ciencia y Tecnología de Carbono (INCAR-CSIC), MATENERCAT, Oviedo, Spain

Type: Oral presentation

The presentation covered the use of a microwave-assisted sol-gel method to prepare synthetic carbon materials with controlled morphology and porosity. The speaker explained how altering the concentrations of the main precursors and the solvents influenced the morphology and porous structure of the materials. The results showed that different synthesis conditions produced structures ranging from isolated spheres to three-dimensional networks, along with changes in particle size, pore size, pore volume and surface area. The speaker also talked about the use of nitrogen-containing precursors such as melamine, urea and ammonia to modify the surface chemistry of the materials. Another interesting aspect of the talk was the incorporation of metallic nanoparticles and the preparation of composites with metallic aerogels to improve metal dispersion and active-site accessibility. I found the talk useful because, although the materials differed from those in my research, the effect of varying synthesis conditions on morphology was relevant to my work on Ga_2O_3 thin films.

Title: Low temperature photonic annealing of metal oxide films for energy applications.

Speaker: Maria Basso

Affiliation: University of Cologne, Germany; 2 - University of Padova

Type: Oral presentation

What struck me about this talk was that low-temperature laser annealing was presented as an alternative technique for processing metal oxide thin films. The speaker pointed out that controlling the microstructure and stoichiometry of metal oxides usually requires high-temperature treatments with controlled atmospheres, which increases energy consumption and limits their use on temperature-sensitive substrates. In contrast, laser-based photonic

annealing enables local, rapid heating, reducing total processing time and thermal budget. The speaker gave examples involving various metal oxide thin films, such as vanadium oxides (VO_2 and V_2O_5), cerium dioxide (CeO_2) and titanium dioxide (TiO_2), with applications in smart windows, gas sensors and solar cells. Laser annealing was new to me, and the talk gave me insight into another heat-treatment method for metal oxide thin films.

Title: Design of High-Temperature Sol–Gel Protective Coatings for Titanium Alloys via Controlled Sol Chemistry and Surface preparation.

Speaker: Berangere Toury

Affiliation: University of Lyon, France

Type: Oral presentation

A topic that interested me was the development of sol-gel protective coatings for titanium alloys used at high temperatures. The speaker described how oxidation at high temperatures can affect titanium alloys and how sol-gel coatings can provide protection. Special attention was paid to controlling sol viscosity to achieve the desired coating thickness and homogeneity. Various surface treatments were examined, including mechanical polishing, chemical activation and femtosecond laser structuring. The results indicated that increased surface energy led to better coating adhesion and reduced crack formation. Both piranha solution treatment and femtosecond laser treatment improved wettability and bonding between the coating and the substrate. Different laser-produced surface patterns were compared, and cavity-type structures gave better results than groove patterns in reducing cracks. I found the effect of substrate preparation especially relevant, as the results showed how treatments carried out before deposition could influence coating adhesion and crack formation.

Title: Structural and optical properties of Ga_2O_3 thin films deposited by chemical solution deposition toward deep-ultraviolet photodetectors

Presenter: Masatoshi Koyama

Affiliation: Osaka Institute of Technology, Japan

Type: Poster

The poster focused on preparing Ga_2O_3 thin films by chemical solution deposition for deep-ultraviolet photodetector applications. The researcher used an aqueous gallium chloride solution as the precursor and added polyvinyl alcohol as a thickening agent. The solution was spin-coated onto c-plane sapphire substrates at 5,000 rpm, then dried at 120 °C and sintered between 550 and 1,000 °C in an oxygen atmosphere. XRD measurements showed that single-

phase β -Ga₂O₃ films were formed at temperatures above 600 °C. The optical measurements showed an absorption edge in the deep-ultraviolet region, while the optical bandgap increased with increasing sintering temperature. Secondary ion mass spectroscopy showed that this increase was caused by the diffusion of aluminium from the sapphire substrate into the Ga₂O₃ films, with diffusion occurring even at 700 °C. This poster was particularly relevant to my research because it used a similar preparation method for Ga₂O₃ thin films and showed how the sintering temperature and substrate could influence their properties.

Title: Phase separation study during the two-step sol-gel synthesis of methyltrimethoxysilane (MTMS)-based aerogels—pH and solvent/antisolvent effect.

Presenter: Monika Klimek

Affiliation: Faculty of Chemical and Process Engineering, Warsaw University of Technology, Poland.

Type: Poster

I was interested in a poster investigating the effect of different synthesis conditions on MTMS-based aerogels. The research looked at how pH and the water-to-solvent ratio influenced phase separation in the two-step sol-gel process. To obtain different sets of samples, the water-to-precursor molar ratio and the pH were changed during both the acidic hydrolysis and alkaline condensation steps. Oxalic acid and ammonia were used as catalysts. The samples had similar density and porosity because the sample volume and MTMS concentration were kept constant. Gelation times were measured and SEM analysis was carried out to compare changes in morphology and average secondary particle size under the different synthesis conditions. The study showed how pH and the water-to-precursor ratio affected phase separation and the formation of monolithic gels. I found the experimental approach interesting because several synthesis conditions were systematically varied and compared across different sets of samples.

Title: Shrinking and spring-back behaviour of methyltrimethoxysilane-based aerogels with different nanostructures during ambient pressure drying.

Presenter: Danny Bialuschewski

Affiliation: University of Cologne, Institute of Inorganic and Materials Chemistry, Cologne, Germany

Type: Poster

The use of ambient pressure drying for MTMS-based aerogels was an interesting aspect of this poster. Silica aerogels normally require supercritical drying to avoid shrinkage caused by capillary pressure and pore collapse. Ambient pressure drying provides a faster and more economical alternative, although the effect of different solvents on MTMS-based aerogels is not yet fully understood. In this study, aerogels were prepared using three different water-to-precursor molar ratios to obtain different initial structures. The gels were then washed with different types of solvents, including protic, aprotic, polar and non-polar solvents, to examine their effects on capillary forces, shrinkage and spring-back during ambient pressure drying. Video analysis was used to monitor changes during drying, while SEM was used to compare samples dried under ambient pressure with those dried under supercritical conditions. I found it interesting to see how both the choice of solvent and the initial structure affected the behaviour of the aerogels during drying.

Conclusion

I would like to express my gratitude to the UKNC for their financial support, which enabled me to attend the Sol-Gel 2026 conference. Attending the conference gave me the opportunity to present my work, meet other researchers and learn about current research in sol-gel processing and thin-film preparation. It was also valuable to discuss my findings with others, broaden my understanding of different processing approaches and consider how some of these could be relevant to my research.