

Chemically driven Cold Sintering Process of silica down to room temperature

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The Cold Sintering Process (CSP) is an innovative consolidation technique enabling densification at low temperatures (below 300 °C) through the combined action of uniaxial pressure and a transient liquid phase. Unlike conventional sintering, CSP relies on solution mediated mass transport, making it particularly suitable for materials such as amorphous silica (SiO_2), which usually require much higher temperatures for densification. Recent studies report relative densities of 70–80% for cold sintered silica-based materials prepared via Strober method, while maintaining the amorphous structure. This is achieved by mixing silica with a small amount of water or a dilute alkaline solution (NaOH), thanks to the low processing temperature. However, preparing amorphous silica under acidic catalysis significantly alters the underlying chemistry, leading to the formation of not only SiO_2 and SiOH functions, but also $\text{Si}(\text{OH})_2$. This modification enhances densification activation factors, both through in-situ water generation from the elimination of OH groups detected by protonic conductivity with impedance spectroscopy and by achieving nearly 98% densification down to room temperature.

These results highlight the potential of CSP as a low energy, scalable processing route for silica-based ceramics and composites prepared in acidic conditions, opening new perspectives for the development of advanced and functional hybrid and composite materials with reduced environmental impact.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

Advanced Engineering Materials (Wiley)

Invitation letter for visa

No

Author: Mrs KORBI, amna (CIRIMAT - ICGM)

Co-authors: Mr ESTOURNÈS, Claude (CNRS Research Director - CIRIMAT); Mrs GERARDIN, Corine (CNRS Research Director); Mr HERISSON DE BEAUVOIR, Thomas (CIRIMAT, Toulouse); Mr RYDZEK, gaulthier (assistant professor in Institut Charles Gerhardt in Montpellier)

Presenter: Mrs KORBI, amna (CIRIMAT - ICGM)

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