

Ion Exchange for Glass Strengthening

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Abstract:

This presentation is an overview of silicate glass strengthening by exchange of alkali ions in a molten salt, below the glass transition temperature (chemical tempering). The physics of alkali inter-diffusion is briefly explained and the main parameters of the process, which control the glass reinforcement, are reviewed. Methods for characterizing the obtained residual stress state and the strengthening are briefly described, along with the simplified modelling of the stress build-up. The fragmentation of chemically tempered glass is discussed. The concept of engineered stress profile glass is presented, and finally, the effect of glass and salt compositions is overviewed.

Questions to be answered:

1. What will be a topic stating an exceptional success to be published in a well known high ranking Research Journal in 2025 concerning your presented R&D field of work? Please think in headlines.

Though this does not directly belong to what I will present:

For the academic research, an exceptional success would be to enlighten and provide real understanding of the relationship (if any) between the intrinsically low toughness of silicate glass and its nature and structure (at the relevant length scales).

I risk a guess: Might be obtained thanks to multi scale modelling? (ab initio, molecular dynamics, and/or at a larger scale) performed on silica,

Investigating (in such modelling) the effect of temperature and water (onset of viscous flow, catalytic role of very small amount of molecular water on the kinetics of oxygen diffusion...)

But also by comparison with the same kind of modelling with other very different materials (crystalline and/or tougher materials, metals, polymers...)

2. Please name up to 10 future key challenges (till 2025) regarding your presented field of expertise and indicate please the specific year when you expect the topic to become a real bottleneck for the future developments.

Glass strengthening : Virgin glass is already strong and does not need strengthening.

A real challenge for applications is how not to spoil this originally very high strength:

Find new surface treatments (including coatings, hybrids, ...) that would effectively prevent the glass strength degradation caused by **contact damaging**.

Application to glass fibers: How to deal with the very large surface involved?

These challenges are already bottlenecks or limitations to a broader use of current glasses in applications where they have to compete with transparent polymeric materials or polymeric foams, or natural fibres etc.

3.) Concerning the topics, what would be

a) the key breakthrough and when is it likely to occur

b) what must happen concerning the research field if this topic will never be successful

I have no real definite ideas about the road mapping and the organisation..