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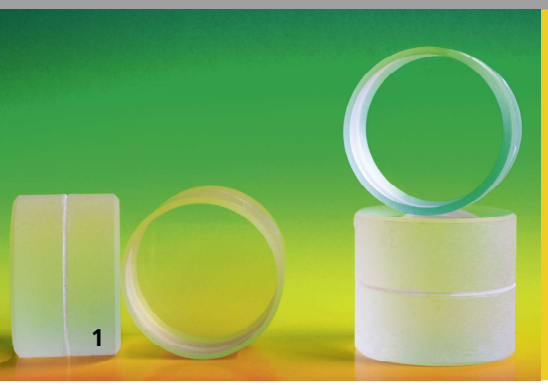
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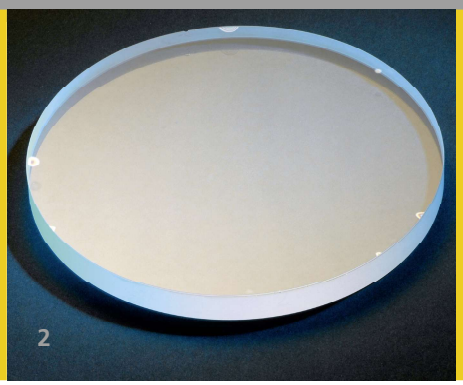
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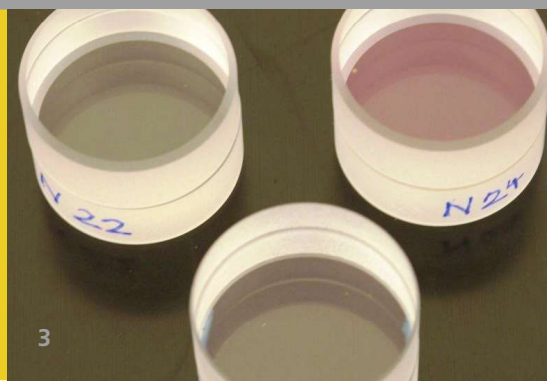
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1 *Silicate Bonding applied to various glass blanks (diameter 25 mm, SiO_2, BK7, glass-ceramics).*

2 *Direct Bonding of a glass wafer to a thick glass substrate (diameter 200 mm, SiO_2, preliminary).*

3 *Direct Bonding of glass blanks (diameter 25 mm, SiO_2, coated and uncoated).*

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BONDING TECHNOLOGIES ADAPTED TO GLASS AND GLASS-CERAMICS

Objective

Development of "adapted" bonding technologies for glass and glass-ceramics using water based silicate solutions or no additives at all ("Direct Bonding") by applying suitable surface activation processes before assembly in a vacuum environment.

Pre-conditions

- Materials with a high SiO_2 content
- Surfaces highly plane (or otherwise conform), flatness at least $\lambda/10$ PV*
- Extremely smooth (polished) surfaces, roughness < 1 nm RMS*

* λ: wavelength (632 nm)
PV: peak-to-valley
RMS: root-mean-square

Bond characteristics

- Full transparency (bonding area is "invisible")
- No uncontrolled creep/drift under mechanical load
- No outgassing at elevated temperatures
- No stress from thermal mismatch (for identical materials)
- Assembly of individual parts "accurate to gage blocks"

Applications

- UV, VIS and IR optics (transmission and reflection)
- Laser applications
- Space applications
- Lithography and precision engineering applications