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Chair	Dr. İlkay Sökmen

Glass to Metal Interaction During Forming

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Biography

Prof. Dr. Christian Roos
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As the current Head of the Chair of Glass and Glass Ceramics at RWTH Aachen University in Germany and the Institute of Mineralogy at RWTH Aachen University, I have been working for more than 25 years on glasses and glass ceramics, their production and properties of a thermo-dynamic, kinetic and structural nature. The sustainable glass production and transitions between glassy and crystalline states are a focus of my work.

From 1998 to 2008 I was a scientist at Schott AG in Germany in international research and development, among other things in the field of production and processing of display glass and the development of glass-ceramics. From 2009 to 2023 I was managing director of the international research association IPGR and in parallel since 2016 head of the above-mentioned Chair of Glass and Glass Ceramics at RWTH Aachen University and since 2019 head of the Institute of Mineral Engineering at RWTH Aachen University.

I am a member of the board of the German Glass Technology Society, editor of the European Journal of Glass Science and Technology and act as a reviewer for the DFG - German Research Foundation, the Journal of Advanced Ceramics, the Journal of the American Ceramic Society, for the Austrian Agency for Research Integrity and for the German Academic Exchange Service. I also was guest lecturer at the University of Jena.

In teaching, I cover the entire breadth of glass technology, starting from thermodynamic and kinetic fundamentals to material properties such as mechanical and thermomechanical properties, glass structure and glass-crystalline transformation through the technological implementation of industrial processes such as melting, molding and post-processing.

Abstract

Forming glass usually requires materials that can withstand direct contact with molten glass. Often such materials often must be protected by the application of lubricants from erosion, glass adhesion and overheating. And consequently, such lubricants often cause adjacent problems such as enhanced corrosion or contamination. These limitations can hardly be overcome without a better understanding of the glass contact behavior. The interaction of glass-melts at viscosities of 102 Pa·s and higher with the respective contact material is very crucial for a successful glass forming process. One key interaction between glass-melt and its contact material is sticking. At a certain point, no smooth, low-friction at e.g. sliding of a glass-gob into a mould occurs and the glass sticks to the respective forming material. The corresponding theory of this behavior is nowadays mostly accepted and has later been refined leading to a hypothesis for sticking which has been introduced by a number of scientists.

The presented investigation aims to establish a new approach for determining glass to contact-material interaction during glass-forming, and it uses this approach to explain why the sticking theory of glass-metal interaction at elevated temperatures needs to be revisited. We first explain the motion of a molten soda-lime glass at elevated temperatures on various materials. We then compare the measured contact angles and capillary numbers with physical theories originally developed for liquids at room temperature. These theories include, in particular, the molecular kinetic spreading model and the model of Mahadevan and Pomeau for droplet dynamics. Furthermore, it is also discussed how the contact behavior of a glass to another material is related to the sticking of glass to the respective material and a new model for glass-metal interaction is proposed.

Notes

References

[1] M. P. Aleksennko, "Cohesion and Adhesion of Hot Glass", Moscow, Mashionstroenie, 1969.
[2] B. G. Abramovich, G. E. Kalashnikov, "Sticking temperature of glass and mold", Glass Ceram., 38, 349–350, 1981, https://doi.org/10.1007/BF00710086.
[3] P. Manns, W. Döll, G. Kleer, "Glass in Contact with Mould Materials for Container Production," Glasstech. Ber. Glass Science and Technology, 68, 12, 389–399, 1995.
[4] M. Falipou, C. Donnet, "Sticking Temperature Investigations of Glass/Metal contacts - Determination of Influencing Parameters", Glastech. Ber. Glass Science and Technology, 70, 5, 137–145, 1997.