Session	Materials Science in Glass (II)
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Chair	Osman Burak Okan

INVITED SPEAKER

Properties of Pure Substances in Their Crystalline, Liquid and Glassy States – Their Relevance for Industrial Glass Development

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Biography

Reinhard Conradt is a retired professor from RWTH Aachen University.
1980 Ph.D. in Physical Chemistry;
1980-86 researcher at Fraunhofer Institute of Silicate Science, ISC Würzburg, Germany;
1987-96 lecturer and industry consultant at Chulalongkorn University, Thailand;
1997-2016 Chair of Glass & Ceramic Compo¬sites at RWTH Aachen University;
since 2017 consultant to glass industry through own company uniglassAC GmbH.

2015-2020; Chairman of the German Society of Glass Technology DGG;
2022-2024; 27th President of the International Commission on Glass ICG.

Most important recognitions and awards;
- International Otto Schott Research Award 2001,
- W.E.S. Turner Award of the International Commission on Glass ICG 2011,
- Fellow of The Society of Glass Technology (SGT, U.K.) 2017,
- L. David Pye Lifetime Achievement Award, The American Ceramic Society 2020,
- Otto Schott Memorial Coin of DGG 2021.

Abstract

Some well-known phenomenological features on the glassy state are recalled first: The enthalpies HGL and entropies SGL of pure substances in their glassy state GL differ from the standard values of their isochemical crystalline states X (resp. their lowest density polymorphs) by distinct positive differences Hvit and Svit, respectively. Between room T and Tg, both states have nearly identical heat capacity. At the glass transition temperature Tg, the heat capacity cGL of a glass jumps towards the value cL of the equilibrium liquid state L within a narrow temperature interval. This jump delta-cP occurs when cGL reaches the Dulong-Petit value cDP = 3·R per g-atom; hence delta-cP = cL – cDP. Thus, the position of Tg of a glass-forming system can be assessed by the cross-over of cGL and cDP. The elastic moduli of both GL and any polymorphs of X show a linear dependence on the atomic packing density p which is inversely proportional to the molar volume VM.

In multicomponent glasses, all above properties superimpose linearly with composition if glasses are treated as homogeneous mixtures of components corresponding to the equilibrium phases k of state X. The above features are by far more than just rules of thumb. It is shown how these features can and should be used in the development of industrial glass compositions.