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The periodic table of the elements and the formation of glasses

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Abstract:

A sufficiently fast cooling rate (i) and a sufficient amount of suitable constituents with directional bonds (ii) are well-known conditions for glass formation from the melt. Extrapolating the enthalpy function of the melt into the range below the melting temperature, T_m, one obtains as a new characteristic criterion to form a glass (iii) the minimum relative temperature interval of undercooling, $\Delta T_{min} / T_m = \Delta H_m / [T_m (2C_{pl} - C_{ps})] = \Delta S_m / (2C_{pl} - C_{ps})$, from the melting enthalpy, ΔH_m, the melting entropy, ΔS_m, and the specific heat capacities at constant pressure of the melt, C_{pl}, and of the crystalline material, C_{ps}: The smaller $\Delta T_{min} / T_m$, the easier is the glass formation. The meaning of condition (iii) is demonstrated using the enthalpy functions of Si and SiO_2 as typical examples from the literature.