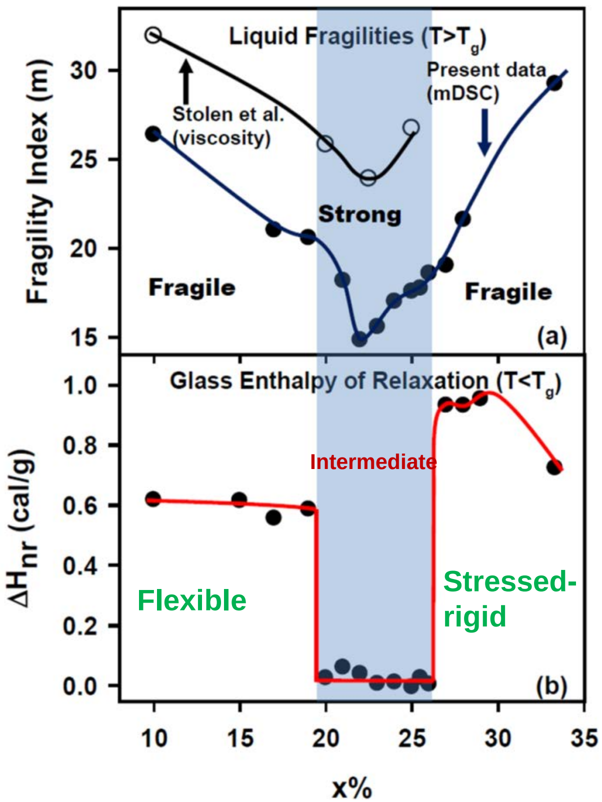
View below Tg correlated to the one above Tg in chalcogenides

Punit Boolchand (Univ of Cincinnati), **DMR-Award # 08-53957**

How do the dynamics and structure evolve as glasses are heated across T_g, the glass transition temperature? In covalent Ge_xSe_{100-x} networks[1] three distinct regimes of network structure exist - (i) *flexible*, (ii) *rigid but unstressed* (*Intermediate phase (IP)-blue region)* and (iii) *stressed-rigid*. Upon melting, two distinct types of glass transitions manifest: *IP* glass compositions display a T_g with a minuscule enthalpy of relaxation (ΔH_{nr} ~0), while those outside the *IP* show a large ΔH_{nr} (panel (b)). In contrast, fragility of melts, m(x) near T_g accessed from Complex C_p measurements[2], and at $T>>T_g$ from viscosity measurements[3]. show (panel(a)) that

- *IP* glasses give rise to *strong* (low m) liquids
- glass compositions *outside the IP* give rise to *fragile* (high m) liquids
- Bonding constraints operative in covalent glassy networks persist in melts as the three regimes in m(x) and ΔH_{nr} (x) coincide in x.



(a)Viscosity derived fragility m (○) [3]. are unable to access fragility m at x > 25% unlike complex C_p measurements[2] from mDSC (●). (b) The non-reversing enthalpy (●) from mDSC experiments show the 3 regimes of elastic behavior[1] describing their underlying network structures.

1. Bhosle et al. J. Appl. Glass Science 1-16 (2012) DOI: 10.1111/j.2041 - 1294.2012.00093.x (in press)
2. K. Gunasekera et al. (under preparation)
3. Stolen et al. Phys. Chem. Chem. Phys., 2002, 4, 3396-3399

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(L-R): S. Ravindren (G), A. Diebold (U), K. Vignarooban (G), K. Gunasekera (G), R. Bhageria (HS), P. Boolchand (PI) and W. VanHook (HS). S. Chakraborty (G), C.Holbrook (G) and Z. Tucker (U) were absent.

S. Ravindren (G) assisting A. Diebold (U) with m-DSC measurements.

Four graduate students (G) working towards their Ph.D. Dissertation benefit directly from the award. They also mentor and provide hands on experience to 2 undergraduates (U) and 2 high school (HS) students on glass science projects. UC's Graduate School Summer Mentorship awardee, S. Ravindren has been working closely with A. Diebold and Z. Tyler on examining synthesis of homogeneous As-Se glasses and their characterization by m-DSC and Raman scattering. The two HS students, W. Van Hook and R. Bhageria have worked closely with K. Vignarooban and the PI on identifying improved synthesis routes to homogenize alkali-borate glasses leading possibly to sharply defined elastic phase transitions. These HS students have come to the lab. once a week, on an average, during the entire year including summer.