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Finding Universals at the Nano-Level Interface for Glasses

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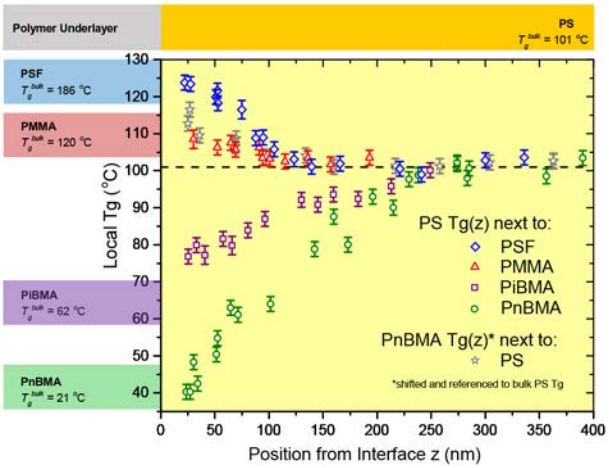
Emory University researchers discover fundamental features for glass transition at the nano-scale with large implications for industrial designers and theorists.



Glass – the non-equilibrium liquid state of a substance that is frozen before transitioning into a crystallized solid state – is used in applications as diverse as filtration, photovoltaic technologies, and bioengineering. Researchers and designers are finding great opportunities for enhancing glasses at the nano-level. Glasses appear to be strongly affected by their components' interfaces at the nano-level.

Emory University physicists Connie Roth and Roman Baglay have been exploring the fundamental question as to how the glass transition temperature T_g is altered by these interfaces at the nano- level and have written on it in January 2017 in *The Journal of Chemical Physics*.

The authors looked at the local glass transition temperature $T_g(z)$ across an interface of polystyrene with different polymers, quantifying the depth to which the local T_g was perturbed near these polymer-polymer interfaces. They found a smooth, broad transition in the local T_g-dynamics across the interface, despite the relatively sharp interface (composition profile) between the two polymers.

Surprisingly, the researchers observed that the key determinant for the $T_g(z)$ profile is whether the neighboring polymer has a higher T_g, forming a hard interface, or a lower T_g, forming a soft interface. Critically, the researchers observe a uniform penetration distance of the interfacial perturbation into polystyrene of 100–125 nm when next to a hard interface and 225–250 nm distance next to a soft interface.

The surprising uniformity might imply a universal behavior for how glasses behave near interfaces, which Roth and Baglay believe is significant for theorists. The study may also have large implications for optimizing nano design of glasses.

Source: "Local Glass Transition Temperature $T_g(z)$ of Polystyrene Next to Different Polymers: Hard vs. Soft Confinement," by R. Baglay and C.B. Roth, *The Journal of Chemical Physics* (2017). The article can be accessed at http://dx.doi.org/10.1063/1.4975168.