A new way of making glass

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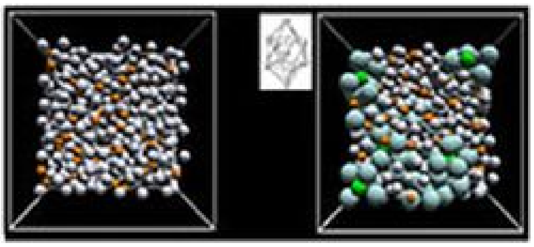

Making glass by changing the structure of a liquid. Left: normal liquid alloy of nickel (silver) and phosphorous (orange) atoms. Encouraging atoms to form bicapped square antiprisms (inset) turned the liquid into a solid glass (right) where the nickel (turquoise) and phosphorous (green) atoms in antiprisms are drawn larger

(Phys.org)—A new way to make glass has been discovered by a collaboration of researchers at the Universities of Düsseldorf and Bristol using a method that controls how the atoms within a substance are arranged around each other. The research is published today in *Physical Review Letters*.

When cooling a liquid below its melting temperature it either crystallizes or transforms into a glass. Glass is a peculiar state of matter: it has the mechanical properties of a solid but an amorphous structure like a liquid.

As long ago as 1952, Sir Charles Frank at the University of Bristol argued that the structure of glasses should not be entirely disordered like a liquid but rather that it should be filled with polyhedra like the bicapped square antiprism.

Although such motifs have very recently been found in experiments and computer simulations on glassy materials, it has not been clear what role these play in how a liquid becomes a (glassy) solid.

The Düsseldorf and Bristol researchers created a new type of glass in a computer by encouraging atoms in a molten nickel-phosphorous alloy to form the pictured polyhedron. When these polyhedra formed, the liquid no longer flowed – it had become a solid. In other words, they found that instead of cooling, a liquid can turn into a glass by changing its structure.

Dr Paddy Royall of the University of Bristol said: "The method we developed employed computer simulations of liquids, performed on the University of Bristol's BlueCrystal supercomputer, where the atoms were driven to form more polyhedra.

"Although many more polyhedra were formed, the atomic arrangements were still disordered rather than a periodic arrangement as seen in crystals. This means that the solid that was formed had to be a glass."

Dr Thomas Speck of Heinrich-Heine-Universität, Düsseldorf said: "These results mean that structure can control whether a material is liquid or solid and thus open the way to design new glasses: for example metallic glasses whose great lightness and strength promise exciting applications and chalcogenide glasses which are used in memory applications and phase switch memory, a possible future technology for data storage."

More information: 'First-order phase transition in a model glass former: coupling of local structure and dynamics' by T Speck, A Malins and CP Royall in *Physical Review Letters*.
prl.aps.org/abstract/PRL/v109/i19/e195703

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