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Experimental Verification of Metallic Glass Prediction from Liquid Data

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Experimental Verification of Metallic Glass Prediction from Liquid Data

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Unlike ordinary metals with crystalline atomic arrangement, metallic glasses or amorphous alloys, have a disordered atomic arrangement with local order extending to nearest and next-nearest neighbors only. From a practical standpoint metallic glasses have many desirable technological advantages over normal, crystalline, metals that make them of potential commercial and military interest. They are much stronger than normal metals and can be processed into intricate shapes using techniques that are similar to those used to prepare polymeric materials. However, the process of metallic glass formation and of how a liquid transforms into a glass (the glass transition) are incompletely understood. Our goal is to go beyond the trial and error methods commonly used to predict whether a liquid can make a good glass, and to devise an algorithm for identifying good glass formers that does not require measuring T_g (the glass transition temperature) beforehand.

We propose that the critical casting thickness (d_{max}), which is a glass forming ability indicator, is correlated with T_{rg} and T_g/T. Based on this we can derive a predictive formula for glass formation. Further, we have shown that T_g/T^*, T_g/T_A, and the liquid expansion coefficient are correlated with T_g. This allows us to predict T_g before making any glass; it can be predicted based on only the liquid data. Using the predicted T_g and the correlation between *log* (d_{max}* d_{max}), T_{rg}, and T_g/T^*, glass formability can be predicted from liquid data alone. Our work will tell us whether our predictive algorithms are capable of pointing to good glass formers and, if so, giving an accurate value for T_g, using only data from the high temperature liquid. Our studies of adding element to destroy the icosahedral structure in alloys will also tell us whether the predictive algorithm needs to correct for a liquid structure term.