# Literature Review Addition SMG Notes

## SMGs

Add in Wang, et al. [1] work on Au52Ag5Pd2Cu25Si10Al6 which confirms low deposition rates at high substrate temps. Produced dTg and reduced enthalpy! Found annealing removes ultrastable effect.

Sputtering plasma add a temperature fluctuation of 20K to substrate [1]. Tg was 400K, meaning sputtering added 5% of Tg temp to substrate. Mg65Zn30Ca5 has Tg = 405K, so expect similar temp rise at substrate.

Add in Aji, et al. [2] work on Zr55Cu30Ni5Al10 which confirms low deposition rates at high substrate temps. Produced dTg and reduced enthalpy! Found annealing removes ultrastable effect. Gains of 30% in hardness and elastic modulus. HRTEM and XRD cannot differentiation between ordinary and SMG (ie appear to have similar structure). STEM techniques can differentiate. SMG displays medium ranged order (MRO) of 2nm, author believes this is responsible for ultrastable effect.

Add MRO theory [2] as additional info to Yu’s work.

Add Wang’s [1] enthalpy plot to lit review.

Note, if enthalpy increases, the Tf also increases (Can be interpreted from enthalpy plots).

The slow deposition rates allow molecules to have sufficient time to rearrange into high efficient packing structures [1-3].

The higher an alloy’s GFA, the more stable it is [2].

Low GFA and low stability compared to other glasses is due to high atomic mobility which allows for fast relaxation at elevated temperatures [2].

SMG could be model material for the study of glass thermodynamics and kinetics [1, 4]

## Sources

[1] J. Q. Wang, N. Chen, P. Liu, Z. Wang, D. V. Louzguine-Luzgin, M. W. Chen*, et al.*, "The ultrastable kinetic behavior of an Au-based nanoglass," *Acta Materialia,* vol. 79, pp. 30-36, 10/15/ 2014.

[2] D. P. Aji, A. Hirata, F. Zhu, L. Pan, K. M. Reddy, S. Song*, et al.*, "Ultrastrong and Ultrastable Metallic Glass," *arXiv preprint arXiv:1306.1575,* 2013.

[3] S. F. Swallen, K. L. Kearns, M. K. Mapes, Y. S. Kim, R. J. McMahon, M. D. Ediger*, et al.*, "Organic glasses with exceptional thermodynamic and kinetic stability," *Science,* vol. 315, pp. 353-356, 2007.

[4] H.-B. Yu, Y. Luo, and K. Samwer, "Ultrastable Metallic Glass," *Advanced Materials,* vol. 25, pp. 5904-5908, 2013.