Shear Processes in Pd\textsubscript{40}Ni\textsubscript{40}P\textsubscript{20} Bulk Metallic Glasses 

D.J. SAFARIK, R.B. SCHWARZ, MST-8; Los Alamos National Laboratory — Depending on the imposed deformation rate, plastic deformation in metallic glasses can be either Newtonian or non-Newtonian. To investigate the influence of deformation history on non-Newtonian plastic flow in bulk Pd\textsubscript{40}Ni\textsubscript{40}P\textsubscript{20} glass we deformed the same volume of the glass specimen along differently oriented glide planes. We found that the glass has a memory of its previous plastic deformation, but this memory is largely independent of the previous glide direction. Loss of the memory follows first-order kinetics with a time constant of 1260 s at 553 K. The transition from Newtonian to non-Newtonian flow is rather abrupt and occurs at a Deborah number, $De = \dot{\gamma} \cdot \tau = 0.5$, where $\dot{\gamma}$ is the plastic shear strain rate and $\tau$ is the time constant for the exponential annihilation of the flow defects. This value of $De$ is consistent with the value of $De \approx 1$ observed at the onset of flow instabilities in liquids. The abruptness of the transition, together with the strong stress-sensitivity of the viscosity in the non-Newtonian regime, suggests that the plasticity agents in the Newtonian and non-Newtonian flow regimes are not the same.