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Shear Processes in $Pd_{40}Ni_{40}P_{20}$ 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 $Pd_{40}Ni_{40}P_{20}$ 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.

D.J. Safarik
MST-8; Mail Stop G755; Los Alamos National Laboratory

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