FATIGUE BEHAVIOR OF GOLD THIN FILMS AT ELEVATED TEMPERATURES STUDIED BY BULGE TESTING

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Even though metallic thin films are widely used in modern electronic devices (e.g. microchips, actuators or sensors), their fatigue behavior at the submicron scale is still not clear. While bulk materials typically show fatigue extrusions that are caused by dislocation processes, other mechanisms must be considered in thin films due to the limited dimensions. In metallic films of submicron thickness, grain boundary cracking and surface roughening supersede the formation of extrusions. Until now, most of the experiments were performed on polymer substrates. Here, an advanced bulge setup was used to cyclically load freestanding gold films of 150 nm thickness in stress-controlled experiments. Temperatures in the range of 25 °C – 100 °C were applied and the main deformation mechanisms were identified by measuring the activation energy and the stress exponent during fatigue testing. Preliminary results suggest a dominance of diffusion-based mechanisms, which is in agreement with the damage localization at grain boundaries. This poster will discuss the fatigue lifetime and observed damage of gold thin films as a function of these two parameters: applied stress range and temperature.