Study on the Thermal Transport and Phonon Attenuation of Metallic Nanofilms/Glass Substrate by Applying Picosecond Laser Transient Thermoreflectance Method

Weigang Ma[C,S]
Department of Engineering Mechanics, Tsinghua University, Beijing, China
maweigang@tsinghua.edu.cn

Tingting Miao
College of Mechanical and Transportation Engineering, China University of Petroleum, Beijing, China

Xing Zhang
Department of Engineering Mechanics, Tsinghua University, Beijing, China

Masamichi Kohno and Yasuyuki Takata
Department of Mechanical Engineering, Kyushu University, Fukuoka, Japan

Thin metal films are widely used as interconnecting wires and coatings in electronic devices and optical components. Reliable thermophysical properties of the films are required from the viewpoint of thermal management. The cross-plane thermal transport and phonon attenuation of two polycrystalline platinum nanofilms with different thickness deposited on glass substrates has been studied by applying the picosecond laser transient thermoreflectance technique. The measurement is performed by applying both front pump-front probe and rear pump-front probe configurations with high quality signal. The determined cross-plane thermal diffusivity of the Pt films greatly decreases compared to the corresponding bulk value, exhibiting significant size effect. The main mechanism responsible for the thermal diffusivity decrease of the present polycrystalline Pt nanofilms is the grain-boundary scattering on the free electrons.