Anomaly Thermal Resistance Reduction on Mo/Amorphous-HfO_2/Mo Three-Layer Thin Film

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Thermal conductivity of amorphous materials has drawn much interest. A heat transport across Mo/amorphous-Al_2O_3/Mo three-layer thin films has been known to reduce its total thermal resistance below Al_2O_3 thickness of less than 3 nm. In this study, the thermal resistance of a series of Mo/amorphous-HfO_2/Mo three-layer thin films with HfO_2 thickness from 2.5 nm to 10.5 nm were evaluated. The thermal resistance decreases like as boundary thermal resistance vanishes as well as Al_2O_3 case. Top and bottom Mo layers with thickness of 100 nm were deposited using dc magnetron sputtering. While, HfO_2 layer was deposited using plasma enhanced atom layer deposition using TEMAH as a precursor. For HfO_2 deposition, the substrate temperature was 150 deg. C to avoid crystallization. Additionally HfO_2 single layer on quartz substrate specimens are simultaneously fabricated to evaluate the density of HfO_2 layer using X-ray reflectivity method. The film structure and HfO_2 crystallinity were characterized using TEM observation and micro-focused electron bean diffraction, respectively. Total thermal resistance of films are evaluated using a rear-heating / front-detection type time-domain thermoreflectance apparatus.