Tuning the transition temperature of WSix alloys for use in cryogenic micro-calorimeters

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Microwave kinetic inductance detectors provide a pathway to highly multiplexed, high resolution, spectroscopic x-ray detectors. Over the past several years we have introduced the concept of the thermal kinetic inductance detector (TKID), which operate as a micro-calorimeter in a quasi-equilibrium mode. As with other micro-calorimeters, the thermal noise of a TKID is reduced when the operating temperature is decreased. However, because the sensitivity of a TKID decreases as the operating temperature drops below ~ Tc/5, the Tc of the resonator material must be tuned to match the operating temperature. We have investigated the WSix alloy system as a material for these detectors. By co-sputtering from a Si and W2Si target, we have deposited WSix films with a tunable Tc that ranges from 5 K down to 500 mK. These films provide a large kinetic inductance fraction and relatively low noise levels. We provide results of these studies showing the Tc, resistivity, and quality factors as a function of deposition conditions. Contrary to expectation, we have observed an increase in low temperature internal quality (Qi) as the Tc decreases. These results show that WSix is a good candidate for TKID x-ray detectors.