Giant enhancement of superconductivity in ultrathin α-Pb films by a parallel magnetic field: effect of magnetic impurity

ASHWANI KUMAR, H. JEFFREY GARDNER, LIUQI YU, PENG XIONG, Department of Physics and MARTECH, Florida State University — An ultrathin superconductor containing paramagnetic impurities is predicted\textsuperscript{1,2} to exhibit \textit{enhancement} of superconductivity ($T_c$ and $I_c$) when subject to a parallel magnetic field. We have recently observed a pronounced enhancement of superconductivity in ultrathin homogeneous amorphous Pb films without any (intentionally added) magnetic impurities in the presence of a parallel magnetic field; the $T_c$ enhancement is as large as 13\% and persists in field as high as 8 T. Our experiments are carried out in a modified dilution refrigerator capable of \textit{in situ} film growth, sample rotation, and incremental deposition of magnetic (Cr) impurities, which allows for a systematic, unambiguous elucidation of the effect of paramagnetic impurities on the field-enhancement of superconductivity. With increasing Cr density on a Pb film, the magnitude of the $T_c$ enhancement is progressively suppressed, contrary to the theoretical predictions. \textsuperscript{1} Kharitonov \textit{et al.}, JETP Lett. 82, 473 (2005). \textsuperscript{2} Wei \textit{et al.}, Europhys. Lett. 75, 943 (2006).