Chlorine-doping effects on crystal structure and superconductivity in FeSe$_{1-x}$Cl$_y$\(^1\) H.H. SUNG, R.R. HU, S.C. CHEN, W.H. LEE, National Chung Cheng University, W.H. LEE TEAM — According to the assessed Fe-Se phase diagram,\(^2\) the FeSe compound could crystallize either in tetragonal Pb-O type structure with space group P4/nmm (called $\beta$ FeSe) or hexagonal Ni-As type structure with space group P6$_3$/mmc (called $\delta$ FeSe) depending on the materials preparation process. In general, different starting composition of FeSe\(_x\) results in a mixture of superconducting phase with almost identical T\(_c\) and different amounts of magnetic impurity, therefore, it was proposed that the tetragonal $\beta$-FeSe superconducting phase ($T_c$ $\sim$ 8 K) only exists in a very narrow Se-deficiency range.\(^3\) Our experimental data indicated that the single hexagonal $\delta$ phase sample could be obtained by carrying out the low-temperature (400 °C) annealing for FeSe$_x$Cl$_y$ after reaction at 680 °C. This result is contrary to what is observed in the FeSe system in which the tetragonal $\beta$ phase is the predominant stable one at the low annealing temperature 400 °C. As compared with the $\beta$-FeSe superconductor reported in the literature, higher T\(_c\) values (> 8 K) and larger superconducting volume fraction could be achieved by suitable tuning and heat treatments in the FeSe$_x$Cl$_y$ system.

\(^1\)Supported by the National Science Council of Republic of China under Contract Numbers NSC 99-2112-M-194-006-MY3 and NSC 100-2811-M-194-015.


W.H. Lee
National Chung Cheng University

Date submitted: 27 Nov 2011