Novel Approach to Efficient Growth of Iron Selenide (FeSe) High-Temperature Superconductors

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Iron-based superconductors (IBSCs) hold a promising future for exhibiting superconducting behavior at increasingly high critical temperatures (Tc), potentially leading to a wide range of applications from efficient electricity transmission to more cost-effective Magnetic Resonance Imaging (MRI). This study covers a more efficient and reproducible growth process of the IBSC Iron selenide, or FeSe, selected for its relative lack of toxicity over other IBSCs, which often contain arsenic and/or a rare earth element. As of now, two main processes are known to grow the FeSe compound in its purest crystal form: vapor transport and flux transport, both of which were investigated in this study. It was found that though the former avoids the issue of contamination by outside compounds, the growth of FeSe crystals is slow and produces few crystals. Although the issue of preventing contact between water and AlCl3 exists in the flux transport, by using a vacuum pump for dehydration and a one-zone furnace, it was shown that a high yield of crystals could be obtained in a much shorter period than found in earlier studies. Through analysis by X-ray powder diffraction, 56% of the crystals grown came in the form of the magnetic, hexagonal phase of FeSe (Fe7Se8), while the remaining came in the form of the superconducting, tetragonal phase of FeSe (FeSe0.98). This researcher concluded that future experiments should be conducted to not only verify this methodology, but to also test it for different materials.