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Electrical and structural properties in Mo-Re alloys; a study on their superconductivity.

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Previous studies [1,2] reported on superconductivity (SC) observed for alloy systems with the general formula $\text{Mo}_{1-x}\text{Re}_x$. In order to probe this behaviour further, three samples $\text{Mo}_{73.5}\text{Re}_{26.5}$, $\text{Mo}_{67.1}\text{Re}_{32.9}$, and $\text{Mo}_{79.5}\text{Re}_{20.5}$ were prepared and characterized. Pure elements, 99.99 % in purity, of Mo and Re were used to synthesize the three samples utilizing the arc-melting technique. Analysis of x-ray diffraction results show that these alloys exhibit both body-centred cubic (BCC) and the A15 phases. The A15 phase, with a β -W crystal structure, is typically observed in intermetallic compounds of the form Y_3Z , where Y is a transition metal, and Z is any element and is associated with superconducting behaviour [3]. The four-probe method was used for resistivity as a function of temperature, $\rho(T)$, measurements. All the samples showed normal metallic behaviour on cooling down from 300 K to the temperature associated with the onset of SC, T_{sc} , where a clear anomaly in the form of a step in the $\rho(T)$ curve is observed. As the applied magnetic fields are increased, the T_{sc} values shift to lower temperatures. Alternating current heat capacity measurements as a function of temperature, $C_p(T)$, were performed. Clear transitions, in the form of humps, are observed in the $C_p(T)$ curves of the $\text{Mo}_{67.1}\text{Re}_{32.9}$ and $\text{Mo}_{79.5}\text{Re}_{20.5}$ samples, corresponding to T_{sc} values of (9.53 ± 0.02) K and (9.98 ± 0.05) K, respectively.

References

- [1] Sundar, S., Chandra, L.S., Chattopadhyay, M.K., Pandey, S.K., Venkateshwarlu, D., Rawat, R., Ganesan, V. and Roy, S.B., 2015. Strong electron-phonon coupling and multiband effects in the superconducting β -phase $\text{Mo}_{1-x}\text{Re}_x$ alloys. *New Journal of Physics*, 17(5), p.053003.
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