Strong Coupling S-wave Superconductivity in Bi$_4$O$_4$S$_3$ - SHRUTI, PANKAJ SRIVASTAVA, SATYABRATA PATNAIK, School of Physical Sciences, Jawaharlal Nehru University, New Delhi, India — We investigate the superconducting properties and pairing symmetry in recently discovered Bi$_4$O$_4$S$_3$ superconductor. A series of Bi$_6$O$_4$S$_4$(SO$_4$)$_{1-x}$ samples were synthesized by solid-state reaction. The optimally doped sample Bi$_4$O$_4$S$_3$ which is 50% SO$_4$ deficient shows maximum $T_c$ of 5.3K as confirmed by resistivity and magnetization measurement. The upper critical field at zero temperature is found to be $\sim 2.75$ T and Ginzburg Landau coherence length is estimated to be $\sim 110\text{Å}$. Hall measurement confirmed the dominant role played by the electrons with charge carrier density of $4.405\times 10^{19}$ cm$^{-3}$ at 10 K. The Sommerfeld constant $\gamma$ is calculated to be 1.113 mJ/K$^2$mol. Supercconducting pairing symmetry and superconducting gap was studied from penetration depth measurement using tunnel diode oscillator technique. It is shown that Bi$_4$O$_4$S$_3$ is a strong coupling $s$-wave type superconductor with fully developed gap. Below $T_c$, superfluid density is best fitted with single gap $s$ wave model with zero-temperature value of the superconducting energy gap $\Delta_0=1.54$ meV, corresponding to the ratio $2\Delta_0/k_BT_c=7.2$ which is much higher than the BCS value of 3.53.

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