Superconducting Tunneling on Cu$_x$Mo$_6$S$_8$ Films*

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Superconducting tunneling junctions were fabricated on sputtered Cu$_x$Mo$_6$S$_8$ films with Al$_2$O$_3$ and SiO$_2$ barriers. The energy gap was determined by the first derivative measurement. The ratio $2\Delta_0/k_BT_c$ obtained in the experiment clearly indicates the strong coupling nature of Cu$_x$Mo$_6$S$_8$. Preliminary results of the second derivative measurements show phonon structure, which agrees reasonably well with inelastic neutron scattering measurements.

1. INTRODUCTION

Ternary molybdenum sulfides (TMS) have been attracting interest because of their unusual superconducting properties. However, due to the complications and difficulties in material synthesis and specimen preparation, tunneling experiments have not been carried out in a satisfactory way. On the one hand, tunneling measurements provide a very useful tool for obtaining quantitative information concerning superconductivity, such as the phonon spectrum, electron-phonon coupling, etc. On the other hand, meaningful quantitative analyses can hardly be expected in compounds as complicated as TMS. To date, only a point contact measurement has been reported on the Chevrel phase Cu$_x$Mo$_6$S$_8$. In general, point contact arrangements are suitable for superconductors like TMS that do not have a good insulating native oxide, but there are difficulties in data reproducibility due to the uncontrollable contact pressure to the specimen, unpredictable mechanical vibration during measurement, and so forth. Such problems can be alleviated in thin-film junctions provided an adequate insulating barrier can be fabricated. In this report we present results of tunneling measurements on Cu$_x$Mo$_6$S$_8$ sandwich junctions. In order to make a tunneling junction on materials like A-15s and TMS, a flat, clean, characteristically superconducting layer immediately underneath the junction interface is

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Fig. 1. (a) Scanning electron micrograph of a typical surface of a Cu$_x$Mo$_6$S$_8$ film deposited on a high-temperature (800–900°C) substrate. (b) Typical surface of a film deposited on a low-temperature (200–300°C) substrate and then annealed at 900°C in a vacuum-sealed quartz tube for 8 h.