Thermoelectric Properties and Microstructure of Ca$_3$Co$_4$O$_9$ thin films on SrTiO$_3$ and Al$_2$O$_3$ Substrates$^1$  
T. PAULAUSKAS, Q. QIAO, A. GULEC, R.F. KLIIE, UIC, M. OZDEMIR, C. BOYRAZ, D. MAZUMDAR, A. GUPTA, UA — Ca$_3$Co$_4$O$_9$ (CCO), a misfit layered structure exhibiting large Seebeck coefficient at temperatures up to 1000K has attracted increasing attention as a novel high-temperature thermoelectric material. In this work, we investigate CCO thin films grown on SrTiO$_3$ (001) and Al$_2$O$_3$ (0001) using pulsed laser deposition. Quality of the thin films was examined using high-resolution transmission electron microscopy and thermoelectric transport measurements. HRTEM images show incommensurate stacks of CdI$_2$-type CoO$_2$ layer alternating with rock-salt-type Ca$_2$CoO$_3$ layer along the c-axis. Perovskite buffer layer about 10nm thick was found present between CCO and SrTiO$_3$ accompanied by higher density of stacking faults. The CCO grown on Al$_2$O$_3$ exhibited numerous misoriented grains and presence of Ca$_x$CoO$_2$ phase. Seebeck coefficient measurements yield an improvement for both samples compared to the bulk value. We suggest that thermoelectric properties of CCO increase due to additional phonon scattering at the stacking faults as well as at the film surfaces/interfaces.

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