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Unusual Superconductivity in the Homologous Series $(Cu_{0.75}Mo_{0.25})Sr_2(Ce,Y)_sCu_2O_{5+2s+\delta}$ OMAR CHMAISSEM, Northern Illinois University and Argonne National Laboratory, Illinois, USA, INGA GRIGORAVICIUTE, MAARIT KARPPINEN, HISAO YAMAUCHI, Aalto University School of Science and Technology, Aalto, Finland and Tokyo Institute of Technology, Yokohama, Japan, MASSIMO MAREZIO, CRETA/CNRS, Grenoble, France — The structures and bulk superconductivity (>30% Meissner volume fraction) of the first four members of the high-T_c series $(Cu_{0.75}Mo_{0.25})Sr_2(Ce,Y)_sCu_2O_{5+2s+\delta}$have been successfully determined. Partial Mo substitution for Cu in the square-chains enhances T_c to 87 K (for s= 1) and leads to significant oxygen loading capabilities well beyond the levels achieved in typical $YSr_2Cu_3O_{6+\delta}$, $YBa_2Cu_3O_{6+\delta}$, and other similar cuprates. Higher members of the series have their adjacent superconducting CuO_2 layers separated by increasingly thicker fluorite-like $(Ce,Y)_2O_2$ insulating blocks. Insertion of two or more of these blocks must drastically affect the CuO_2 interlayer coupling and causes T_c to immediately drop and saturate at ∼57 K (s = 2-4). The infinite chains of Cu-centered squares in YBCO change to alternate chains of mixed Cu squares and Cu and Mo octahedra. Neutron diffraction confirms the formation of reservoir blocks with a new structure and stoichiometry and of a surprisingly large Cu oxidation state of ∼2.5+, suggesting the possibility of an unusual superconducting pairing mechanism.

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