Origin of superconducting carriers in “non-doped” T’-(La, RE)$_2$CuO$_4$ (RE = Sm, Eu, Gd, Tb, Lu, and Y) HIDEKI YAMAMOTO, AKIO TSUKADA, NTT Basic Research Labs., MASUMI NODA, Tokyo University of Science, MICHIKO NAITO, Tokyo University of Agriculture and Technology — We have reported the isovalently-substituted new superconductors T’-La$_{2-x}$RE$_x$CuO$_4$ ($T_c \sim$20-25K) prepared by MBE with no effective dopant. As regards the origin of the carriers in these nominally non-doped superconductors, there seems to be two possible scenarios: (i) oxygen deficiencies at the regular oxygen sites serve as a source of effective electron carriers, and (ii) they are not Mott insulators and have intrinsic carriers. Since precise information on the site-specific occupancy of oxygen is very difficult to obtain, alternatively, we investigated the in-plane lattice constant $a_0$ with changing $RE$ concentration $x$, with a view to examining possible $a_0$ expansion due to electron doping. In each $RE$ substitution, the $a_0$ of the T’-La$_{2-x}$RE$_x$CuO$_4$ linearly decreases with increasing $x$, whose extrapolation to $x=2$ agrees well with the reported value for bulk T’-RE$_2$CuO$_4$. This variation can simply be understood based on the difference in the ionic radius of RE$^{3+}$ vs La$^{3+}$, suggesting that these superconductors are not electron-doped, at least substantially, and that the second scenario is the more plausible. This conclusion is also supported by the results of transport and photoemission experiments.

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