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$T_c$ vs Isotopic Mass and vs Residual Resistivity Investigation in MgB$_2$ MARINA PUTTI, University of Genova, MATTEO TROPEANO, PAOLO BROTTO, CARLO FERDEGHINI, ENRICO GALLEANI, PIETRO MANFRINETTI, ANDREA PALENZONA — Almost five years after the discovery of superconductivity in MgB$_2$ the isotope effect on $T_c$ is not yet understood (M. Calandra et al, Physica C456, 38 (2007) and references therein). The isotope effect is mainly due to the B atoms reflecting the important role of B vibrations in determining $T_c$. Detailed two bands calculation leads to $\alpha(B)$ of the order of 0.4–0.45, in disagreement with experiments which evaluated $\alpha(B) = 0.30$. Anharmonicity was proposed as a possible explanation for the reduced B isotope coefficient, but recently it was emphasized that such an explanation needs to be reconsidered. On the other hand, recent investigations on the effect of disorder on $T_c$ pointed out that samples with residual resistivity ($\rho_0$) of few $\mu\Omega\text{cm}$ present $T_c$ variations comparable with the intrinsic variations due to isotopic effect. This calls for new investigations of isotopic effect in samples with controlled amount of disorder. Ultra clean Mg$^{10}$B$_2$ and Mg$^{11}$B$_2$ samples ($\rho_0 \sim 0.5 \, \mu\Omega\text{cm}$) were damaged respectively with annealing and neutron irradiation and $T_c$ and resistivity were measured. $T_c$ vs $\rho_0$ plot shows in both cases a linear relationship allowing us to extrapolate $T_c (\rho=0)\Omega\text{cm}$ for both the sample series. $\alpha(B)$ evaluated by these intrinsic $T_c$ values confirms results of previous report and the crucial role of disorder in determining $T_c$ has been proved.

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