Effect of trace elements and quenched-in vacancies on precipitation hardening in Al-1.7at%Cu alloy

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Al-Cu alloy is a common precipitate hardenable alloy which is used in many industrial applications such as fuselage in aviation and automobile [1]. Microalloying is a typical method to control precipitation behavior as well as mechanical properties of Al-Cu alloy [2]. Here we study the influence of trace elements In, Sn, Sb, Bi and Pb (100 ppm) and their interaction with quenched-in vacancies on the precipitation decomposition in Al-1.7at% Cu alloy (5N5 base Aluminum) during ageing by PAS techniques. In and Sn are bound to quenched-in vacancies at RT and up to 150 °C and hence prevent copper atoms from diffusion which in turn change the precipitation sequence. On contrary, Sb, Pb, and Bi, which have theoretically high binding energies to the quenched-in vacancies [3], show no interaction with the vacancies. Free vacancies as well as In and Sn atoms accelerate precipitation kinetics i.e. nucleation of θ′ phase which is the reason of the peak hardness.

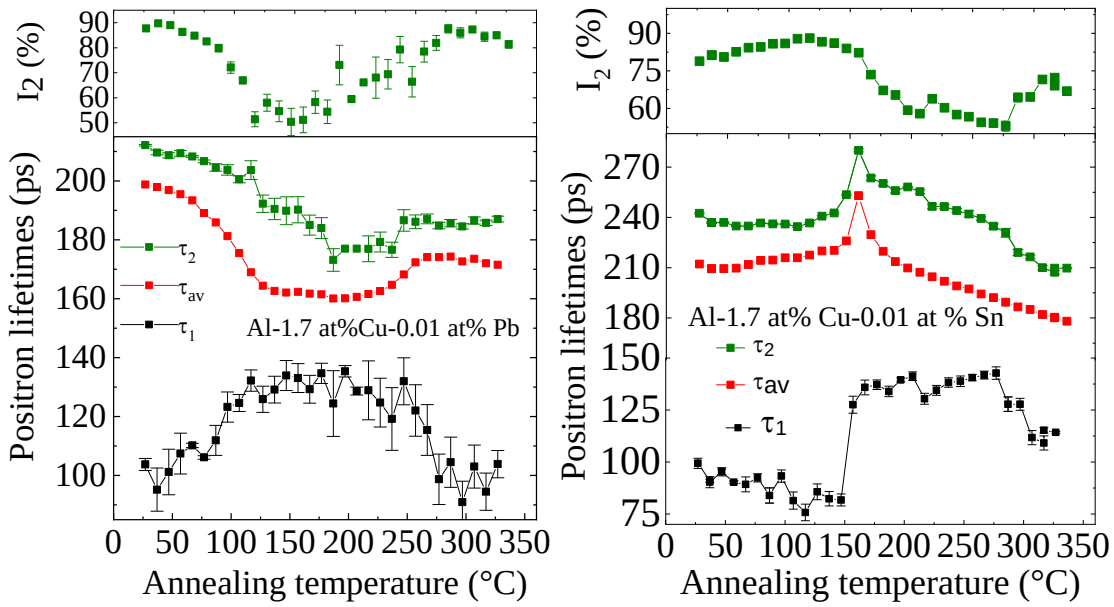

Figure 1 Positron annihilation lifetime measurement of quenched Al-1.7 at.% Cu with 100 ppm Pb and Sn as a function of isochronal annealing. Both alloys quenched at 520°C to ice water.

References

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