LOW TEMPERATURE RESISTIVITY OF Ag-Pd ALLOYS

E.Babić i Ž.Marohnić
Institute of Physics of the University Zagreb

The low temperature resistivity of Ag-Pd alloys varies dramatically with changing the concentrations of the components. For less than 10at% of Ag the dependence is $+T^2$, between 10 and 60 at% Ag is $-T^2$ and above 60 at% is again $+T^2$. Edwards et al[1] have proposed that the exchange enhanced scattering of conduction electrons by clusters of holes causes the low temperature resistivity of alloys with 25-55at% Ag measured by them. They assumed that Pd atoms in Ag matrix form virtual bound states (v.b.s.) well below the Fermi level. By increasing Pd concentration these states are broadened due to interaction and approach the Fermi level. The statistical fluctuations in Pd concentrations favour the clustering of Pd atoms with v.b.s. reaching the Fermi level and thus forming the holes. The resonant scattering of the conduction electrons by these holes causes $-T^2$ resistivity dependence. At lower Pd concentrations v.b.s. (well below the Fermi level) have less influence on the resistivity causing $+T^2$ dependence. For very high Pd content, Pd atoms form their own delocalized d-band which also produces $+T^2$ resistivity dependence. This interpretation is suported by recent resistivity[2] and optical[3] measurements. The latter results[3] prove the existence of v.b.s. and their broadening by increasing the Pd concentration.

Our aim was to investigate this sistem in a full concentration interval and to see in a more detail the regions where T^2 dependence changes to $-T^2$ and vice versa. Ag-Pd alloys of 19 different concentrations (starting with pure Ag and ending up with pure Pd) have been made in an argon arc furnace. The concentrations of the alloys were determined by weighing the components and the neglibly small weight loss after melting. The resistances of the samples were measured by a low impedance potentiometric set up with a relative accuracy better than 10^{-5}. All measurements were performed between 1.5 and 40K in a vacuum cryostat imersed in He^4 bath. The resistivity results for several representative

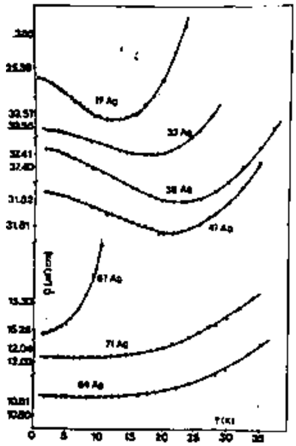

Fig.1.
Electrical resistivity of AgPd alloys vs temperature

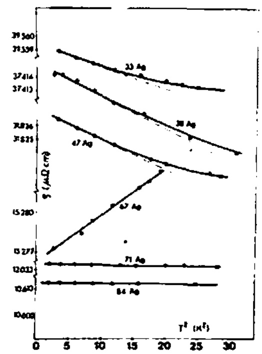

Fig.2.
Resistivities of AgPd alloys of medium concentrations vs T^2

samples are shown in Figs.1 and 2. Low temperature $+T^2$ resistivity dependence is emphasised in Fig.2 where the data are ploted vs T^2. This and our other data are consistent with the earlier results[2)] and strongly support the model based on exchange enhanced scattering on the v.b.s. of Pd atoms. However for a more quantitative comparision between the theory and experiment some additional measurements (cf. magnetic susceptibility, magnetoresistance) have to be done. This work is now in progress.

References:

1) L.R.Edwards,et al,Sol.St.Comm.8(1970)1403
2) A.P.Murani, Phys.Rew.Lett.33(1974)91
3) M.J.Lafait,Compt.Rend.279B(1974)59