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Nanoscale spatial non-homogeneity of 3D Δ_π in $Mg_{1-x}AlB_2$ single crystals F. BOBBA, F. GIUBILEO, A. SCARFATO, A. M. CUCOLO, CNR-INFM SUPERMAT Lab. And Physics Dept., University of Salerno, Via S. Allende, 84081 Baronissi (SA), Italy, D. RODITCHEV, Institut des Nanosciences de Paris, Université Paris 6 et 7, CNRS (UMR 75 88), 75015 Paris, France, N. ZHIGADLO, S. KAZAKOV, J. KARPINSKI, Solid State Physics Laboratory, ETH Zurich, CH-8093 Zurich, Switzerland — We have performed local I(V) and dI/dV(V) measurements on high quality $Mg_{1-x}Al_xB_2$ single crystals with different Al dopings by means of Scanning Tunneling Spectroscopy (STS). Both temperature and magnetic field dependences of the conductance spectra have been studied both in S-I-N and in S-I-S configurations. The measured spectra revealed only one gap at low temperatures as expected for pure c-axis tunneling. In the case of x=0.1, the measured superconducting gap $\Delta_{\pi g}$ appeared highly non-homogeneous in its spatial distribution on nanometer scale, with an amplitude varying between 1.5 meV and 2.3 meV. In pure MgB_2 the evolution of the zero bias conductance (ZBC) in magnetic field clearly showed two different regimes with a fast rise up to 1 T, followed by a slower refilling of states for higher fields. This effect results smoothed in doped single crystals. Consistently with the more recent theories, in comparison with the undoped material, we have found that for x=0.1 the Δ_π gap value and the H_{c2} critical field increase of about 15% and 30%, respectively.

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