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Direct imaging of structural domains in iron pnictides

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The parent compounds of iron-arsenide superconductors undergo first order structural transition between tetragonal and orthorhombic phases at a temperature, T_S. In AFe$_2$As$_2$ (122) compounds (A=Ca,Sr,Ba) this occurs simultaneously with magnetic transition at T_M. Using a combination of polarized light microscopy and spatially-resolved high-energy synchrotron x-ray diffraction we show the orthorhombic distortion leads to the formation of 45°-type structural domains in both 122 and 1111 single crystals. Domains penetrate through the sample thickness in the c-direction and are not affected by crystal imperfections such as growth terraces. The domains form regular stripe patterns in the plane with a characteristic dimension of 10-50 μm. In a range of low Co-doped compositions structural domains and superconductivity coexist. With the increasing doping level the domain structure becomes more intertwined and fine due to a decrease in the orthorhombic distortion. This results in an energy landscape with maze-like spatial modulations favorable for pinning and intrinsically high critical current densities in the underdoped regime. M.A.Tanatar *et al.* Phys. Rev. B **79**, 180508 (R) (2009). R. Prozorov *et al.* arxiv: 0909.0923, Phys. Rev.B accepted.