Spatially Inhomogeneous Competition between Superconductivity and the Charge Density Waves in $YBa_2Cu_3O_{6.67}$

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Application of magnetic field induces new charge density wave (CDW) order in the high-temperature superconductor $YBa_2Cu_3O_{7-x}$ (YBCO), which can be defined as ferro-coupled CDW (F-CDW) [1, 2]. It can be differentiated from the conventional antiferro-coupled CDW (or AF-CDW) [3, 4] by their c-axis correlations. This discovery has provoked a number of questions such as how does superconductivity compete with two CDW orders? and are either of these orders responsible for the electronic reconstruction? High-energy x-ray diffraction experiments were carried out to find a clue to those questions. The intensity of F-CDW order in $YBa_2Cu_3O_{6.67}$ was investigated as a function of magnetic field and temperature. We found that F-CDW order exists from low-field range B ~ 5 T, and regions of the sample with F-CDW order suppress superconductivity stronger than those with AF-CDW order. It implies that the superconducting state in some regions is more fragile than that in the other regions [5]. In addition, F-CDW order has sufficiently long correlation length to explain the reconstruction of the electronic state. Our study shed a light on the role of F-CDW order in superconducting and normal state properties of underdoped YBCO.

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