Scanning micro-x-ray diffraction unveils the distribution of oxygen chain nanoscale puddles in $YBa_2Cu_3O_{6.33}$

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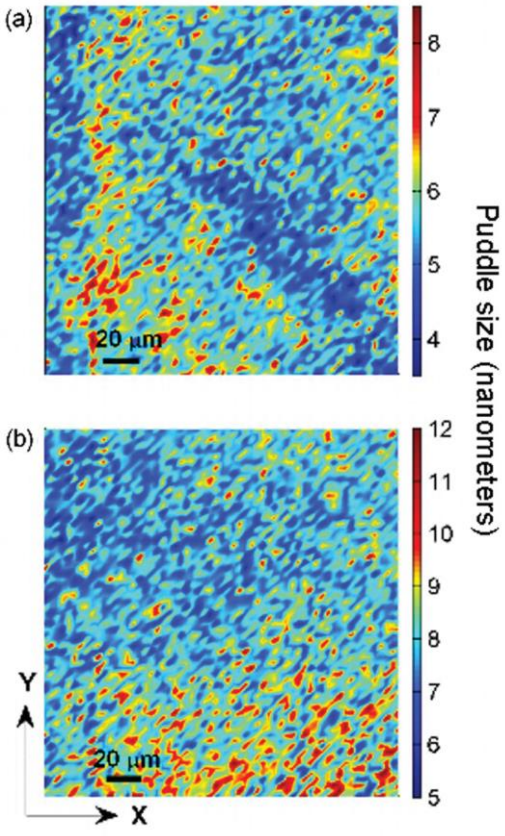
Oxygen chain fragments are known to appear at the insulator-to-superconductor transition in $YBa_2Cu_3O_{6+y}$ .However, the self-organization and the size distribution of oxygen chain fragments are not known.

Here, we seek to fill this gap, using scanning micro-x-ray diffraction, which is an imaging method based on advances in focusing a synchrotron radiation beam. This approach allows us to probe both real-space and *k*-space of high-quality $YBa_2Cu_3O_{6.33}$ single crystals with T_c = 7 K. We report compelling evidence for nanoscale striped puddles, with Ortho-II structure, made of chain fragments in the basal Cu(1) plane with local oxygen concentration y = 0.5. The size of the Ortho-II puddles spans a range between 2 and 9 nm. The real-space imaging of Ortho-II puddles granular network shows that superconductivity, at a low hole-doping regime, occurs in a network of nanoscale oxygen ordered patches, interspersed with oxygen depleted regions. The manipulation by thermal treatments of the striped Ortho-II puddles has been investigated focusing on the spontaneous symmetry breaking near the order-to-disorder phase transition at T_0 = 350 K.



References

[1] Campi, G. *et al.* Scanning micro-x-ray diffraction unveils the distribution of oxygen chain nanoscale puddles in $YBa_2Cu_3O_{6.33}$ *Physical Review B***87**, 014517+ (2013).