ESRF	**Experiment title:** Local structure changes in BaPb1-xBixO3 as a function of temperature correlated with CDW onset by dispersive XAS	**Experiment number**: **HC-2577**
Beamline: ID24	**Date of experiment**: from: 15 giugno 2016 / 21 giugno 2016	**Date of report**: 26 FEB 2018
Shifts: 18	**Local contact(s)**: Virginia Monteseguro Padron	*Received at ESRF:*

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Report:

Introduction. It is known that high temperature superconductors are complex materials however it is not known if complexity is detrimental or favors quantum coherence at high temperature. As a matter of fact the bismuthate superconductors [1] seem to be the archetypal systems to study the emergence of quantum coherence and lattice fluctuations in a systems where a polaronic electronic component is close to a metal to insulator phase transition. Recently the nanoscale phase separation was found by high resolution electron microscopy in superconductive samples $BaPb_{1-X}Bi_XO_3$ for 0.1<x<0.3 [2].

These results have shown these doped perovskite systems are similar of to cuprates [3-7] vanadium diboride [8,9] doped diborides [10,11] and pressurized sulfur hydrides [12-14]. These unconventional superconductive materials are near a metal to insulator transition or in the proximity to a Lifshitz transition in multiband Hubbard models [15]. These system particular complex phases are characterized by a particular case of correlated disorder like biological systems in the living state in quasi stationary states out of equilibrium [16]. The open problem is how this particular disorder promotes quantum coherence. XANES spectroscopy [17-20] is an ideal tool to probe the local structure near a selected atomic site characterized by a short measuring time. In the present work we have used scanning micro XANES to probe the local strain fluctuations in complex oxides $BaPb_{1-x}Bi_xO_3$. We have obtained the statistical spatial strain distribution at the Pb sites measuring the Pb L_3-edge XANES spectra providing further information scanning micro x-ray diffraction

Results and discussion: In order to span the superconducting dome three single crystals with x=0.19, 0.25 and 0.28 have been investigated as a function of temperature between 300K and 5 K. The experiment*s* have been carried out at the energy dispersive X-ray absorption beamline ID24 of the European Synchrotron Radiation Facility (*ESRF*) in *Grenoble*, France, equipped with an energy dispersive XANES spectrometer and a unique setup for real-space scanning and low temperature measurements.

The absence of moving parts, due to the particular setup of the beamline, provides a small and stable focal spot (5×5 μm^2) with a photon flux of 10^{14} ph/s at Pb and Bi L_3-edges, necessary for the scanning micro-XANES.

Using scanning micro-XANES [19-20] in the dispersive mode we have unveiled features of inhomogeneity extending from nanoscale to microscale in $BaPb_{1-x}Bi_xO_3$ superconducting samples. The real space distribution of the local lattice distortions as a function of doping and temperature, have been obtained my micro mapping the sample surface.
Local structure around the photo-absorber obtained by the Pb and Bi L_3-edge XANES spectra of these crystals show clear differences of the bond length with picometer resolution going from one to another spot. By spatial mapping we have obtained the local strain fluctuations at the Pb and Bi sites. The chemical homogeneity and strain inhomogeneity have been determined.
We have found clear evidence for the coexistence of polaronic distorted and flat lattice portions in the superconducting range. The key result of this work has been the clear evidence of a correlated disorder with power law distribution in the low temperature superconducting case which support the emergence of the superconducting phase in a filamentary hyperbolic space [4-6]

Conclusions-This work has developed a direct way to measure the statistical distribution of local strain field in a superconducting crystal, with picometer resolution supporting the paradigm that particular lattice inhomogeneity in these systems giving evidence for a fractal structure near a strain quantum critical point with percolating metal pathways in a heterogeneous polaron metal [19] which promotes quantum coherence [5,6]

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