Liquid crystals are ordered soft materials consisting of assembled molecules. They can be used as new functional materials for electron, ion, or molecular transportation, sensory, catalytic, optical, and bio-active materials [1,2]. Herein, we describe new approaches to functionalization of liquid crystals and show how the design of liquid-crystalline structures formed by supramolecular assembly and nano-segregation leads to the formation of a variety of new functional soft materials.

1) T. Kato, N. Mizoshita, K. Kishimoto Angew. Chem. Int. Ed. 2006, 45, 38.
2) T. Kato Science 2002, 295, 2414.

Keywords: liquid-crystal polymers, liquid-crystal structures, self-assembly supramolecular chemistry

MS.13.1

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Exploring the phase diagram of $La_{2-x}Ba_xCuO_4$: Spins, stripes, and superconductivity

John M Tranquada[1], Genda Gu[1], Markus Huecker[1], Guangyong Xu[1], Masaki Fujita[2], Kazuyoshi Yamada[2]
[1]Brookhaven National Lab, Condensed Matter Physics & Materials Science Dept., Bldg. 510A, Upton, NY, 11973-5000, USA, [2]Institute for Materials Research, Tohoku University, Katahira, Sendai 980-8577, Japan, E-mail：jtran@bnl.gov

The layered structure of copper-oxide superconductors results in highly anisotropic properties. Single-crystal samples are essential for proper characterizations, especially with scattering techniques. While high-temperature superconductivity was first discovered by Bednorz and Mueller in $La_{2-x}Ba_xCuO_4$ (LBCO), this particular system has been one of the more challenging for the growth of crystals, at least for $x > 0.1$. The growth of LBCO crystals is complicated by the fact that the Ba concentration in the melt is much higher than that in the resulting crystal; nevertheless, persistent effort with the floating-zone technique has finally led to the successful growth of large crystals with x as large as 0.155. The availability of these crystals has enabled a broad range of characterizations, including elastic and inelastic neutron scattering, diffraction with soft and hard x-rays, infrared reflectivity, angle-resolved photoemission, scanning tunneling microscopy, magnetization, and transport measurements. We have been able to demonstrate the presence of charge and spin stripe ordering over a range of doping centered on x=1/8. Furthermore, although stripe order correlates with a strong suppression of bulk superconductivity, recent results provide evidence for two-dimensional superconductivity coexisting with stripe order at temperatures as high as 40 K. Another important cuprate system is $Bi_2Sr_2CaCu_2O_{8+d}$. One of us (Gu) has recently succeeded in growing very large crystals (50 mm x 7 mm x 1-7 mm) of the 91-K superconductor. These have made possible direct studies of spin fluctuations and phonons by inelastic neutron scattering.
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Keywords: crystal growth, copper oxide superconductors, charge density waves

MS.13.2

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High quality single crystals for neutron experiments

Geetha Balakrishnan
University of Warwick, Physics, Department of Physics, University of Warwick,, Coventry, Coventry, CV4 7AL, UK, E-mail：G.Balakrishnan@warwick.ac.uk

To make headway on any problem in physics, high quality single crystals are required. In this talk, emphasis will be placed on the crystal growth of selected superconducting and magnetic materials (oxides, borides and borocarbides) using the Optical Image furnaces at the University of Warwick. The floating zone method of crystal growth used in these furnaces, produces crystals of superior quality, circumventing many of the problems associated with, for example, flux growth from the melt. Especially large volumes of crystal may be grown by this method, a prerequisite for most neutron scattering experiments. Some examples of experimental results from crystals grown at Warwick, selected from numerous in-house studies and our collaborative research projects with other UK and international groups will be discussed.

Keywords: floating zone technique, magnetic materials, neutron scattering techniques

MS.13.3

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Tailor-made single crystal growth of high-Tc superconductors for characterization by spectroscopy

Hiroshi Eisaki
National Institute of Advanced Industrial Science and Technology (AIST), Nanoelectronics Research Institute (NeRI), 1-1-1 Central 2, Umezono, Tsukuba, Ibaraki, 305-8568, Japan, E-mail：h-eisaki@aist.go.jp

Due to a tremendous scientific effort over the past 20 years, our understanding of high-temperature superconductivity in the lamellar copper oxides has greatly improved. In particular, significant progress in spectroscopic measurements, such as neutron and x-ray scattering, angle-resolved photoemission spectroscopy, scanning tunneling spectroscopies, have played a major role to probe the electronic properties and the nature of the elementary excitations in these class of materials. To make these experiments possible, availability of dedicated and well-characterized single crystal samples are always required, and indeed these samples have contributed in bringing a lot of interesting informatin. In my talk, I will discuss how the crystal growth efforts and spectroscopic studies are mutually benefitted from each other, mainly based on our case studies.

Keywords: high-Tc superconductivity, spectroscopy, floating zone method

MS.13.4

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Layered and cubic cobaltites grown by floating zone, structural and magnetic properties study

Ekaterina V. Pomjakushina[1], Kazimierz Conder[1], Marian Stingaciu[1], Andrey Podlesnyak[2]
[1]Paul Scherrer Institute, Laboratory for Developments and Methods, PSI, Villigen, AG, 5232, Switzerland, [2]Hahn-Meitner-Institut, SF-2, Glienickerstr. 100, Berlin 14109, Germany, E-mail：ekaterina.pomjakushina@psi.ch

Cobaltites create a large family of compounds possessing a wide range of unique properties such as superconductivity in water