MS16.03.02 LOW-FREQUENCY VIBRATIONAL CONTROL OF CRYSTAL GROWTH FROM MELT. E.V. Zharikov(1,2), A.Z. Myaldun(2), A.I. Prostomolotov(3), N.A. Verezub(3). (1)D. Mendeleev University of Chemical Technology of Russia; (2)General Physics Institute of Russian Acad.Sci.; (3)Institute for Problems in Mechanics of Russian Acad.Sci.

Influence of low-frequency (LF) vibrations on growth process and crystal perfection originating from vibrational control of melt flows and heat-mass transfer at crystal growth excite now rising interest of both crystallographers and hydromechanics. The practical importance of forced vibrational convection connected with the fact that the introdusing flows allow to influence on crystal quality, to control temperature field, thickness of boundary layer and to supress temperature oscillations in the melt near the interface by the complex interaction with flows of natural and thermocapillary convections.

Experiments on growth of doped yttrium-scandium-gallium garnet (Tm = 2156 K) by CZ-technique were carried out with applying of LF-vibrations with frequencies and amplitudes preliminary determined by physical modelling of the process. Microprobe analysis of grown crystals shows essential positive effect of the LF-vibrations on crystal perfection. In particular, LF-vibrations can reduce fluctuations of dopant concentration and related striations in the crystal at least by one half. They also can provide flat interface due to strong influence on heat-mass transport processes near the front of crystallization.

MS16.03.03 LIQUID PHASE EPITAXY OF HT$_c$ SUPERCONDUCTORS. P. Görnert, T. Aichele, S. Bornmann, C. Dubs, Institut für Physikalische Hochtechnologie e.V., Helmholtzweg 4, PF 100 239, D-07702 Jena, Germany

$YBa_2Cu_3O_{7-x}$ films were grown on (110) $NdGaO_3$ substrates by liquid phase epitaxy (LPE) using the "step cooling technique". A transition from c-axis to a- axis orientation could be observed with increasing undercooling for different flux melt compositions. Polygonized macrosteps were revealed optically at c- axis films grown at small undercoolings. Atomic force microscopy (AFM) measurements show that macrosteps are composed of a multitude of smaller growth steps. Besides decorated step structures were found on terraced surfaces between the macrosteps. The high quality of epitaxy has been confirmed by X-ray diffraction measurements showing rocking curve widths (FWHM) of 0.2-0.3° for the (005) film reflection. Larger undercoolings of the flux melts result in mixed c/a-axis growth and finally in a-axis growth reported already earlier.

MS16.03.04 GROWTH AND CHARACTERIZATION OF C_{60} AND C_{70} CRYSTALS. Kenichi Kojima and Masaru Tachibana, Department of Physics, Faculty of Science, Yokohama City University, 22-2 Seto, Kanazawa-ku, Yokohama 236, Japan

The success in efficiently synthesizing fullerenes has generated much interest in the physical properties of this new class of molecular crystals. The growth of single crystals with high quality is required for studies on the intrinsic physical properties. In this work, C_{60} and C_{70} crystals of large size and high quality were grown from vapor by a continuous pulling technique, and their perfection were examined by X-ray topography and etching method.

C_{60} crystals of small size were used as the source material, which was deposited onto the closed end of a pyrex tube. The tube was evacuated to $1\text{-}3\times10^{-6}$ Torr and then sealed off. The tube was placed in a horizontal furnace with two oppositely oriented temperature gradients, where the temperature of the middle portion of the furnace was kept at 530°C and its opposite sides were at 580°C. The tube was advanced towards the source at a pulling rate of 1 cm/day in the furnace. After 3-4 days, C_{60} crystals up to a size of about 8x4x3 mm^3 were grown at the middle of the furnace. C_{70} crystals were also grown in the same way as C_{60}. Here it was necessary to use higher temperatures of the furnace since the vapor pressure for C_{70} is lower than that for C_{60}.

The perfection of the grown C_{60} crystals with fcc structures were examined by synchrotron topography. Some of dislocations were individually observed. Most of their Burgers vectors were identified to be 1/2<110>. Moreover, dislocation etch pits were observed by immersing the grown C_{60} crystals into toluene for 5 seconds. From the distribution of the etch pits, the dislocation density in most of the grown crystals was estimated to be less than 10^4 /cm^2.

To make sure of the characteristics of defects, the mechanical properties, such as hardness and plasticity, of C_{60} and C_{70} crystals were investigated using the microindentation technique.

MS16.03.05 CRYSTAL GROWTH AND CHARACTERIZATION OF NLO ACTIVE ORGANIC INCLUSION COMPOUNDS. Jürg Hulliger, Olaf König, Vera Kramer-Hoss, Institute of Inorg., Analyt. and Physical Chemistry, University of Berne, Switzerland.

Design of efficient organic nonlinear optical (NLO) materials attempts a molecular hyperpolarizability β_{zzz} up to a value close to 10'000 $10^{-40}m^4/V$ and seeks for an orientation of β_{zzz}- axes that optimizes either frequency doubling (SHG) or the electro-optic (EO) effect of macroscopic crystals [1-3].

On account of a low yield [1-3] of crystal structures providing a parallel alignment of dipoles (max. EO effect), recent interest focused on the packing of NLO molecules along parallel channels of inclusion type lattices [4]. When compared to other host materials [5], perhydrotriphenylene (PHTP) worked out to be ideally suited [6,7] to include a variety of linearly shaped NLO entities of the A-π-D type (A, D: acceptor, donor group, respectively; π: thiophene, stilbene, polyphenyl, polyacetylene). SHG powder tests revealed that PHTP-(A-π-D) inclusion formation produces polar materials at a yield of around 75% that is 3 times higher than found for corresponding single component systems. Crystals of PHTP-(A-π-D) were grown by (i) controlled isothermal evaporation of 2-butanone or paraldehyde, (ii) the temperature difference technique, and (iii) by sublimation [8].

[1] D S. Chemla, J. Zyss (Eds.), Nonlinear Optical Properties of Organic Molecules
and Crystals, Vol. 1,2, Academic Press (1987).
[2] J. Zyss (Ed.), Molecular Nonlinear Optics, Academic Press (1994).
[3] Ch. Bosshard, K. Sutter, Ph. Pretre, J. Hulliger, M. Florsheimer, P. Kaatz, P. Gunter, Organic Nonlinear Optical Materials, Gordon and Breach (1995).
[4] V. Ramamurthy, D.F. Eaton, Chem. Mater., 6, 1128 (1994).
[5] E. Weber, Topics in Current Chemistry, Vol. 140, Springer (1987).
[6] J. Hulliger, O. Konig, R. Hoss, Adv. Mater., 7, 719-721 (1995).
[7] R. Hoss, O. Konig, V. Kramer-Hoss, U. Berger, P. Rogin, J. Hulliger, Angew. Chem., submitted.
[8] J. Hulliger, Angew. Chem. Int. Ed. Engl. 33, 143-163 (1994).

MS16.03.06 GROWTH AND CHARACTERIZATION OF $(Y,Nd)Al_3(BO_3)_4$ AND $(Y,Gd)Al_3(BO_3)_4$ CRYSTALS. Leonyuk, N.I.; Koporulina, E.V.; Belokoneva, E.L.; Titov, Yu.V., Moscow State University, Russia

The crystals of solid solutions based on the $YAl_3(BO_3)_4$, $NdAl_3(BO_3)_4$ and $GdAl_3(BO_3)_4$ borates with huntite type structure (R32 space group) are excellent materials for laser and acoustic devices [1,2]. However, the NdAl- and GdAl-borates and their solid solutions tend to the phase transitions from huntite type structure into monoclinic modifications [3]. The purpose of the present work was to establishe a correlation between the growth conditions, contens of crystals and phase transitions in $(Y,Nd)Al_3(BO_3)_4$ and $(Y,Gd)Al_3(BO_3)_4$ solid solutions.

These crystals were grown from a $K_2Mo_3O_{10}$- containing fluxed melts in temperature range 1060-990°C (spontaneous crystallization) or 1050-1010°C (TSSG).

The distribution coefficient (K=Cs/Cl) was estimated to be