15-Crystal Growth

PS-15.02.15 HOW CAN WE SOLVE PROBLEMS OF CRYSTAL GROWTH OF ORGANIC KNO MATERIALS? SELECTION OF METHODS, TEMPERATURE AND SOLVENTS OF ORGANIC KNO CRYSTAL GROWTH. By Changhai Wang, Beijing Institute of Technology, China.

High quality organic crystals are needed for X-ray diffraction structure analysis and for use as nonlinear optical devices. Current routine and nonconventional methods of growing organic crystals are discussed and the influence of temperature and organic solvents on the characteristics of organic KNO crystals was examined experimentally. Growing methods and conditions of MONA, MDSA, MDAA, PMDD according to their physical and chemical properties are made and these are more suitable for organic KNO materials. In actual practice a growth method can not give suitable for different organic crystals. Alternatives of growth method are according to the crystal chemistry and properties of the particular compound. Several examples from recent research work serve to illustrate this point. The organic KNO materials have usually hyperporphyrin molecules, but most typical organic solvents are a dipolar medium lower than 1 Dobson. Therefore, the ideal solubility and similar dipole solvent at least selected to growing large three-dimensional crystals can be expected to grow in the solution. The solvent molecules tend to form low-dimensional crystalline and a polar solvent favors formation of bulk crystals. Many organic compounds are usually used below 200°C and that at high temperature, Propylene oxide was selected by thermal example DME and optical request. An crystal growth practitioners know that the art of crystal growth is much more highly developed than the science much work need to be done to improve existing methods for organic crystal preparation. The effects needed to be interdisciplinarily involving organic chemistry, crystallography and materials science. As a result, we believe that crystal growth mechanism are rational and stable. Interactive, interdisciplinary approaches are needed to make advances in this field and the future utility of organic solid as technologically important materials depends on such advances.B. Zheng et al., J. of Crystal Growth 1995, 150: 511-516.

PS-15.02.17 INVESTIGATIONS OF CONTROLLED REVERSION OF SOLID-LIQUID INTERFACE DURING GROWTH OF YAG:Nd CRYSTALS. By Xu Tianhua, Feng Wening, Zheng Qiming, Huang Changmin and Xu Guangyu, Southwest Institute of Technical Physics, PO Box 238, Chengdu 610041, P.R. China.

There are four clearly differentiated states of liquid flows that can be found in various combinations of diameters and rotation rates of the crystals, namely, I. simple natural convection; II. coexistence of natural and forced convection with an asymmetric overheating region caused by the "windflow effect"; III. coexistence of the same liquid flows but without that region and IV. simple forced convection. In general, states I and III last long, while state II is short state IV occurs when the diameter of the crystal is large in comparison with the inner diameter of the crucible and when the difference in temperature is relatively small between the crucible and the crucible. In all mentioned transitions, namely, I → II, II → III and III → IV, abrupt changes in the diameter of the crystal and remelting of the growth interface to a certain extent were observed. Component supercooling and generation of dislocations occur frequently. It is obviously undesirable to grow the crystals in states II and III. In order to grow in state III, it is necessary for the crystals to go through states I and II and the two rapid transition processes which cause component supercooling and generate dislocations. In this connection, we have developed a method called "Controlled Reversion of Solid-Liquid Interface" (CRLI), which allows the growth to go into state III immediately after a dissolution-free top has grown during state I, and thus to obtain crystals free from dislocations. The key to realize the "safe" transition from I to II is: 1. choosing a suitable position; 2. setting-up of a suitable thermal field; 3. keeping the crystal growth in a stable liquid flow rate; 4. not having the residual of the region of unstable growth appearing inevitably during the interface reversion. When crystals are grown following this procedure, the growth process as a whole is not continuous in space and time, and thus has broken the normal procedure.

PS-15.02.18 COMPARISON OF THE GROWTH OF YAG:Nd CRYSTALS IN RESISTANCE AND RF HEATING SYSTEMS. By Xu Tianhua, Feng Wening, Zheng Qiming, Huang Changmin and Xu Guangyu, Southwest Institute of Technical Physics, PO Box 238, Chengdu 610041, P.R. China.

We have grown YAG:Nd crystals in a graphite heating molybdenum crucible and in an RF heating iridium crucible, separately, and found that there is an appreciable distinction between them in the growth conditions (atmospheric, thermal field and liquid flow behaviours), the growth parameter control (stability of the diameter, permissible growth rate and doping level), as well as in the results on the growth of the crystal (external shape, surface morphology and absorption spectrum). In the first case, when filled with argon (oxygen cannot be used), the furnace was in a reductive atmosphere, the surface of the crystal was severely contaminated due to an interaction between graphite, molybdenum and the constituents of the crystal, and the crystal had an absorption peak near 3700 Å. In the second case, the furnace was in an neutral atmosphere (Ar and/or N2), and the crystal had a wide absorption peak near 2600 Å. The above mentioned peaks can be eliminated by a long-term atmospheric annealing at a temperature ranging from 1200°C to 1300°C. With regard to the setting-up of the thermal field, the first case usually shows a larger (to be suitable) regulating range of the longitudinal and radial temperature gradients, as well as a higher doping level and growth rate than in the second case. The doping levels (the atomic ratios in the starting materials) were larger than 5 % and 4 %, respectively, their pulling rates were 2.0 to 5 mm/hr and 1.0 to 1.3 mm/hr, respectively. Even in such conditions, the normal crystal/charge ratio for the first case (resistance