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The duality of agarose gels as either impurity or impurity filter in protein crystal growth experiments has been discussed frequently. But, up today, we don't know if agarose gels operate as an impurity, as an impurity filter or both. Therefore a series of experiments have been performed using gelled solutions (low concentration agarose) and ungelled solutions to simultaneously study the effect of gels and impurities on the growth kinetics of biomacromolecule crystals. The growth of crystals from highly purified (99.99% purity) and commercial grade (98.5%) lysozyme was observed by Laser Confocal Microscopy combined with Differential Interference contrast Microscopy (LCM-DIM). Step velocities, 2D nucleation rates and normal growth rates were measured. These growth parameters were separately assessed for crystals growing from pure and commercial grade solutions. It was found that 2D nucleation rates are enhanced by the presence of gel fibers that act as heterogeneous nucleation sites. These results also show that the specific surface energy is similar for the gel fiber/crystal interface and for the gel fiber/solution interface. This is consistent with the observed incorporation of agarose fibers into the lysozyme crystal lattice and the small effect of gel fibers on step velocity for crystals growing from highly purified solution. The presence of agarose significantly modifies the step velocity in crystals growing from impure solutions, shifting these values closer to the velocities measured in purified solutions. This velocity increase corresponds to a 7 fold reduction in the concentration of adsorbed impurities at the crystal surface with respect to ungelled experiments and can be considered as direct evidence of the diffusive impurity filtering concept.

Keywords: protein crystal growth, agarose gel, impurity filtering

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Self-organized eutectic microstructures towards photonic crystals and metamaterials

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Eutectics are special materials which are both a MONOLITH and a MULTIPHASE MATERIAL.[1] They may find application in the field of photonic crystals and metamaterials.[2, 3] The eutectic microstructure can exhibit many geometrical forms. It can be regular-lammelar, regular-rod-like, irregular, complex regular, quasi-regular, broken-lamellar, spiral and globular. The most interesting from the point of view of photonic crystals would be the microstructures with regular shapes, i.e. lamellar and rod-like. For metamaterials applications the other shapes could be also of interest - for example the percolated structures (for giant dielectric constant); or the spiral one for chiral metamaterials. The general overview of the road of eutectics towards photonics as well as new experimental data will be presented.

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Keywords: eutectic crystalization, self-organization, photonic crystals and metamaterials

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Desktop Minstrel UV™: A novel protein crystal monitoring automation system using UV fluorescence

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Identifying protein crystals in crystallization droplets has long been considered a challenging step in the field of protein crystallography. Although there are numerous automated crystallization robots readily available, none have been able to successfully monitor crystal growth by distinguishing protein crystals from non-protein crystals and detecting crystals from drops that are otherwise difficult to see with visible light. In order to fulfill this critical need, Rigaku has developed a novel protein crystal monitoring automation system, the Desktop Minstrel UV™, which uses UV fluorescence microscopy. The system includes an ultraviolet microscope with at least one ultraviolet light emitting diode, providing illumination with the wavelength matching the absorption of the fluorescing amino acids, such as tryptophan. To greatly decrease photo-damage to the protein crystals, the fluorescing light illuminated on the sample is reduced to the minimum and is then digitally recorded by a camera with a CCD sensor. We have conducted crystallization experiments with various proteins in order to evaluate this system. The resulting UV images from these experiments clearly reveal the protein crystals from non-protein crystals, such as salts. In addition, this UV crystal monitoring system is built upon the platform of Rigaku's state-of-art imaging automation technology, the Desktop Minstrel, which makes the evaluation of a large number of crystallization experiments possible. The Desktop Minstrel UV enables researchers to accurately harvest protein crystals for data collection or design follow-up experiments.

Keywords: crystallization robots, imaging, UV fluorescence

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The microcapillary protein crystallization system

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The Microcapillary Protein Crystallization System (MPCS) embodies a new, semi-automated, microfluidic plug-based crystallization technology which allows researchers to conduct nanoliter-volume screening of crystallization conditions and to perform in-situ X-ray diffraction studies on crystals that form. The MPCS integrates formulation of crystallization cocktails with preparation of the crystallization experiment. Within microfluidic Teflon tubing or the microfluidic circuitry of a plastic CrystalCard, ca.10-20 nL volume droplets can be generated, each representing a traditional