Project title: I. Photopolymers Materials (Light Sensitive Organic Materials): Characterization and Application to 3D Optical Fabrication and Data Storage

Priority Research area: Engineering, (Also – Nanotechnology and New Materials, AND Physical Sciences)

Principal Investigator details:

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NOTE: We wish to build new collaborative networks to work with and complement our existing programs.

Project Background: Photopolymers are Organic Photosensitive Plastics - you shine light on them they change their properties! They are extremely important materials in the creation of the next generation of optical and optoelectronic devices, (solar cells, integrated 3D optical circuits, data storage discs, rogue solitary waveguides). In 2000 we proposed – The Non-Local Photopolymerisation Driven Diffusion Model. This was the first model to accurately describe the kinetics of photo-polymerisation, that is the growth of polymer chains caused by exposure to light in photosensitive organic materials. As an example of applications we note that the holographic recording of data on holographic discs can potentially allow 100s of movies to be stored on a single CD/DVD sized disc. But what material can we use to retain that much information safely and how does such a material work? DVDs hold ~50GB, and high-density magnetic tapes hold ~1TB (~400 million pages). Tape libraries are made by connecting cabinets each holding ~5,000 tapes and ~20,000 cabinets are sold each year. However, tape performance cannot be greatly increased into the terabyte range.

Candidates: This project is applied research oriented and has a strong practical engineering flavour. The student undertaking it should be highly motivated and prepared to work as a member of an active and diverse research group. Strong interest in optics, mathematics, computer programming and scientific instrumentation would be a plus.

Typical tasks Involved: Work as a member of a research group. Literature search (read papers about photopolymer materials, optics and holography). Collaborate in developing models (theory/maths) and simulation tool (computer software). Record holograms and do experimental work in the laboratory. Implement holographic recording and replay set-ups, capture intensity measurements and process this data.

Some of our relevant publications:

- J. T. Sheridan, "Generalisation of the boundary diffraction method for volume gratings," J. Opt. Soc. Am. A, Vol. 11, No. 2, pp. 649-656, (Feb.) 1994.
- J. T. Sheridan, J. R. Lawrence, "Non-local response diffusion model of holographic recording in photopolymer," J. Opt. Soc. Am. A-Opt. Image Sci. and Vision, Vol. 17, No. 6, pp. 1108-1114, 2000.
- J. V. Kelly, M. R. Gleeson, C. E. Close, J. T. Sheridan, "Optimized scheduling for holographic data storage," J. Opt. A-Pure and Appl. Opt., Vol. 10, No. 11, Art. No. 115203, (Nov.) 2008.
- S. Liu, M. R. Gleeson, J. Guo, J. T. Sheridan, "High intensity response of photopolymer materials for holographic grating formations," Macromolecules, Vol. 43, No. 22, pp. 9462-9472, (published on line 26th Oct.) (23rd Nov.) 2010. http://pubs.acs.org/doi/full/10.1021/ma101723y DOI: 10.1021/ma101723y
- M. R. Gleeson, J. T. Sheridan, F.-K. Bruder, T. Rölle, H. Berneth, M.-S. Weiser, T. Fäcke, "Analysis of the holographic performance of a commercially available photopolymer using the NPDD model," Opt. Exp., Vol. 19, No. 27, pp. 26325-26342, 2011.
- M. R. Gleeson, J. Guo, J. T. Sheridan, "Photopolymers for Use as Holographic Media," Chapter 6, *New Polymers for Special Applications*, InTech Publishers, 2012. ISBN: 980-953-207-498-1. http://dx.doi.org/10.5772/46242.

We regularly exchange students with collaborators in Spain, Germany and Canada and are also involved in collaborative work with Industry, e.g. Bayer Material Science.

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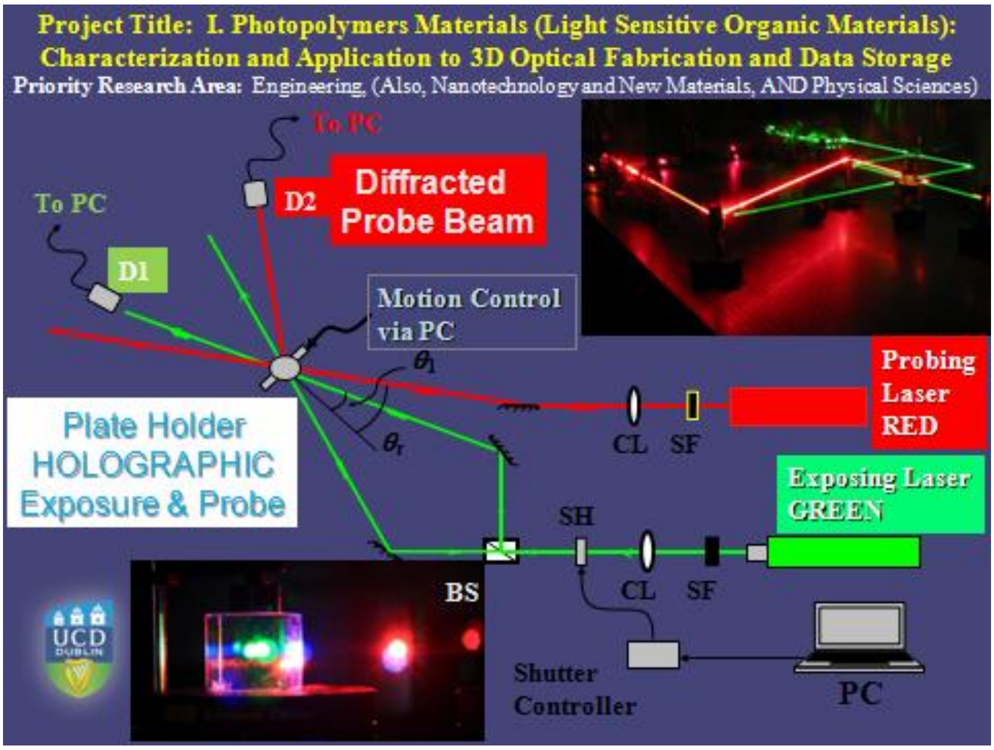

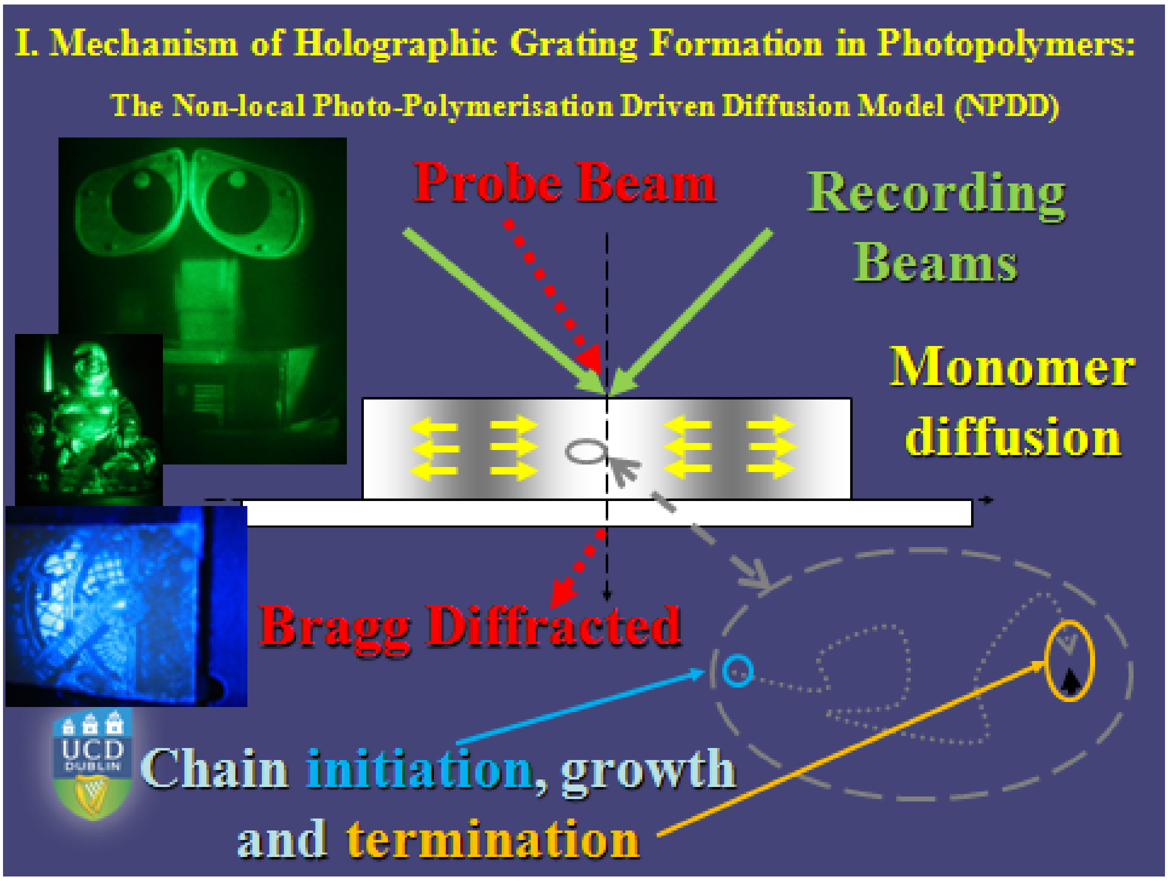
I. Mechanism of Holographic Grating Formation in Photopolymers:
The Non-local Photo-Polymerisation Driven Diffusion Model (NPDD)
Probe Beam
Recording Beams
Monomer diffusion
Bragg Diffracted
UCD DUBLIN
Chain initiation, growth and termination


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