Liquid interfaces: where order emerges from disorder

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Bulk *solids* exhibit long range three-dimensional order. So do their surfaces, although surface reconstruction to a different order often occurs. By contrast, bulk *liquids* exhibits short range order, extending to distances of a few molecules only. A fundamental question that we (and many others) have been exploring is whether the termination of a bulk liquid by an interface could induce molecular order in the near-interface region, and if yes, what would be its characteristics. Answering this question experimentally proved to be far from simple. The advent of synchrotron-based surface-specific x-ray diffraction methods three decades ago, and, in particular, of high-energy beamlines just a few years ago, opened the way for studies of liquid surfaces and deeply buried interfaces with high accuracy and atomic resolution.

Following a brief introduction to the x-ray methods used for studying the nanoscale structure of liquid/vapour, liquid/liquid and solid/liquid interfaces, a few seminal studies of liquid/vapour interfaces, e.g. water, complex fluids, and liquid metals will be discussed. The main body of the talk will focus on recent, and ongoing, atomic resolution structure studies of interfaces, made possible by the recent advent of microfocus, high-energy, beamlines at third-generation synchrotrons. These studies will include surface freezing in surfactant-decorated oil/water interfaces, ordered liquid/liquid electrochemical interfaces, monolayer ordering and melting at solid/alcohol interfaces, and monolayers and interfaces of room-temperature ionic liquids, a novel class of liquids currently under intensive study as possible "green" replacement for present environment-endangering solvents and working fluids in many applications.