about 20 would be needed, requiring doses of 0.08 Gy for a nuclear volume of 250 μm^3, or 2.8 Gy for a nucleotide volume of 3.5 μm^3. Such numbers are far larger than those proposed by Mills *et al.*

Finally, an explanation for the ablation effects seen by Mills *et al.*[1] may, in part, be that about 1 in 10 cell nuclei in their exposed monolayer would have received energy depositions from interactions with 6.5-keV iron X-rays from the Mössbauer source. Such low-energy X-rays have a high relative biological effectiveness[6].

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Surface-plasmon microscopy

SIR—We recently introduced surface-plasmon microscopy (SPM)[1] as a new optical imaging technique with specific advantages for low-contrast thin-film samples like a lipid monolayer transferred from the water–air interface to a solid substrate. We claimed[2] that other light-microscope techniques, such as phase-contrast or Nomarsky microscopy, fail if one wants to see the coexistence of expanded and condensed domains of a single monolayer transferred at its phase transition pressure without the use of fluorescence labels to enhance the contrast between the two phases[3,4]. Sheppard *et al.*[5] dispute this claim but rather than comment on their somewhat surprising results, obtained with a monolayer film of ω-tricosenoic acid and scanning optical microscopy, we prefer to substantiate our claim that only the high resonance contrast[2] achievable in SPM allows one to study thin-film samples of very low thickness and/or index variations.

A monolayer of dimyristoylphosphatidic acid (DMPA) forms a quasi-two-dimensional system, known to undergo a lateral pressure-induced first-order phase transition from an expanded liquid-analogue to a condensed solid-analogue phase. The two phases can coexist over a broad density range (Fig. 1*a*). If a suitable fluorescent dye is added to the lipid layer the coexistence can be observed directly: because the dye is less soluble in the condensed phase it is squeezed out of the growing crystalline domains[3,4], which appear dark in a picture made by fluorescence microscopy (Fig. 1*b*).

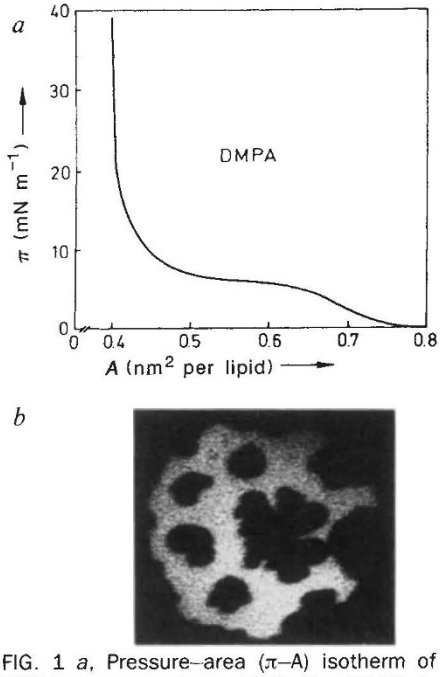

FIG. 1 *a*, Pressure–area (π–A) isotherm of DMPA on pure water, pH 5.8, T = 25 °C. *b*, Fluorescence microscope picture of a DMPA monolayer at the water surface. Dark areas, crystalline domains with a low solubility of the fluorescence dye used.

SPM permits the imaging of such a monolayer without the need for a fluorescent label. The experimental set-up is fully described in ref. 1, but the essence of the method is that a p-polarized beam of laser light of wavelength λ is applied, by means of a prism, at an angle θ_1 to a metal–dielectric interface, where it excites surface plasmons (PSP) whose wavevector fulfils the momentum matching condition $k_{sp}=k_{photon}$, where k_{photon} is the parallel component of the photon wavevector. The energy–momentum relation for the PSP, which gives k_{sp}, is determined by the optical architecture of the interface and, in particular, by the thickness and the dielectric functions of the metal and the coating, respectively. Any small local change in the thickness or the real and/or imaginary part of the complex index of refraction of a thin coating therefore changes this resonance condition slightly, which gives rise to the high contrast between different coatings that can be achieved with SPM.

The PSPs that are reflected, diffracted or scattered by the interfacial (coating) inhomogeneities couple out via the prism and are Fourier-backconverted (by a simple lens in our case) to form an image in real space. This is demonstrated in Fig. 2 for a DMPA monolayer transferred onto a gold substrate without any dye added. The interference pattern in the bright areas of each picture arise from insufficient spatial filtering.

Despite the lower lateral resolution (compared with the fluorescence microscope picture), which is — for our set-up — about 5 μm (ref. 7), it is evident that the same dendritic growth figures can be identified as in the presence of the dye. In addition, however, SPM enables us to perform a more quantitative analysis of the optical properties of the coexisting domains, as we will report in detail elsewhere (W.H. and W.K., in preparation). Given the thicknesses of the condensed and expanded monolayer (d_1 = 2.25 nm and d_2 = 1.65 nm, respectively)[8] we obtain indices of refraction n_1 = 1.51 and n_2 = 1.304 for the two different phases. The lower value for the fluid (amorphous) domains is consistent with a remarkably low electron density found for this phase by X-ray data (C. Helm and H. Möhwald, personal communication) but may, in addition, indicate a further expansion of these areas on deposition to the substrate.

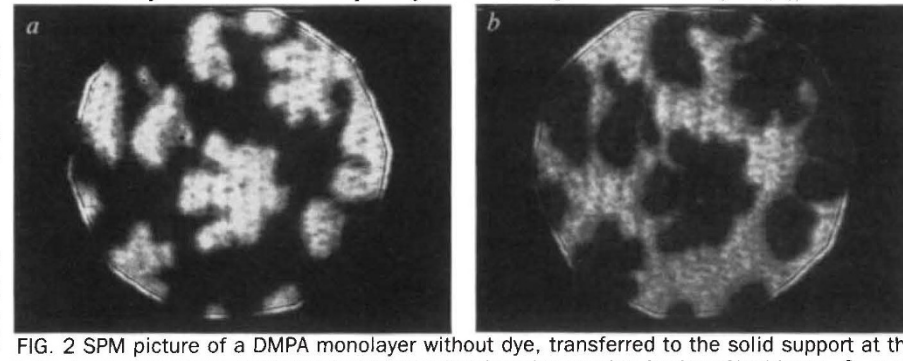

FIG. 2 SPM picture of a DMPA monolayer without dye, transferred to the solid support at the lateral pressure where condensed and expanded domains coexist. Angles of incidence, θ_1, were *a*, 47.20° and *b*, 47.70°.

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Erratum

SIR—In the Scientific Correspondence on cold fusion in the 27 April issue of *Nature* (p. 711) by A. J. McEvoy and C.T.D. O'Sullivan, the first author's name is misspelt and the last sentence of the first paragraph should read: "If this number could be increased by a factor of 10....". □