We established this virus to continuous CEM cell line and compared its biological properties with the original isolate maintained in PBL. We tried to isolate each type of virus using OKT4 A or soluble CD4 for selection. The results, summarized in the table, suggest that one virus can be selected by the cultivation in continuous cell lines (CEM, H9, HUT 78 or B-lymphoblastoid cell), and the second in the PBL culture by selection using soluble CD4 or OKT4 A[7]. Molecular analysis of cloned and sequenced PCR product of the V4 and adjacent domains of BRU 84 PBL (JBB–LAV) revealed at least two types of clone, one corresponding to the published sequence by Wain-Hobson *et al.*[5] and another to deletions of V4 domain characteristic of the sequence of Guo *et al.*[6]. After passage in CEM only one type of clone, corresponding to the sequence described in ref. 5, was found.

These results indicate that in the JBB–LAV preparation two viruses at least were present. We do not know whether they were present from the beginning in the same patient, as was described in other cases[8,9] and selected by cultivation in PBL amplifying the second virus (not detected in June 1983 at the first attempt to grow this virus in CEM[2]), or whether there could have been contamination with another isolate made in our laboratory which was not equipped with P3 facilities.

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Hope for photonic bandgaps

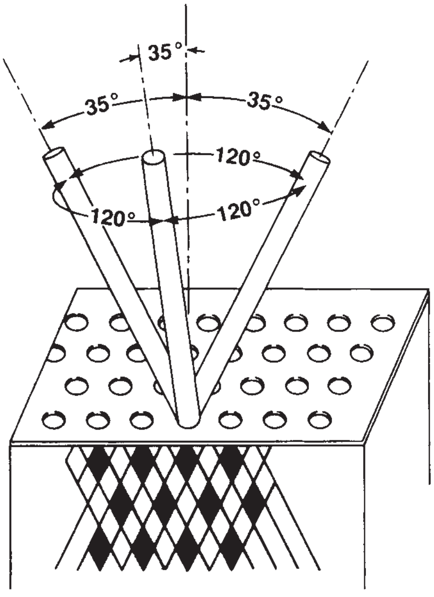
Sir — The search for photonic bandgaps has not bitten the dust, John Maddox suggests[1]. We have recently created three-dimensionally periodic dielectric structures which are to photon waves as semiconductor crystals are to electron waves. That is, these photonic crystals have a photonic bandgap, a band of frequencies in which electromagnetic waves are forbidden[2,3], irrespective of their direction of propagation. Photonic bandgaps inhibit the spontaneous emission of the frequencies concerned and allow for a new class of electromagnetic microcavities.

The creation of a photonic bandgap has proved to be more difficult than expected. It was clear from the outset that a face-centered-cubic (f.c.c.) array in real space would produce the roundest brillouin zone in reciprocal space. But what should be the shape of the atoms? Early suggestions were for cubic atoms[2], then spherical atoms and spherical voids[4]. There has been a long search for that optimal three-dimensional dielectric geometry favoured by nature and by Maxwell's equations. Most of this work has been done with macroscopic dielectric structures, when the forbidden wavelengths are in the microwave region.

During this same period, electronic band theorists began calculating photonic band structure. It rapidly became clear that the familiar scalar-wave band theory, so frequently used for electrons in solids, was in utter disagreement with experiment on photons. Recently, a full vector-wave band theory[5,6] became available, which not only agreed with experiment but highlighted some discrepancies in experiment. Vector-wave band theory showed that the spherical void structure allowed a degeneracy between valence and conduction bands at the W-point of the brillouin zone, resulting in a pseudogap, rather than a full photonic bandgap. The solution to this symmetry-induced degeneracy problem is to make the atoms nonspherical.

The figure shows a practical, new, f.c.c. structure, which simultaneously solves the two outstanding problems in the fabrication of photonic band structure. In this new geometry, the atoms are not spherical, but, rather, are distorted along $<111>$, lifting the degeneracy at the W-point of the brillouin zone and permitting a full photonic bandgap rather than a pseudogap. Furthermore, this fully three-dimensional f.c.c. structure lends itself readily to microfabrication on the scale of optical wavelengths. It is created by simply drilling three sets of holes 35.26° off vertical into the top surface of a solid slab or wafer, as can be done for example by reactive ion-etching. At refractive index $n \sim 3.6$, which is typical of semiconductors, the three-dimensional forbidden photonic bandgap width, calculated and measured, is about 20 per cent of its centre frequency. Calculations indicate that the gap remains open for refractive indices $n \gtrsim 2$.

If the $<111>$ distortion is severe enough, the result can be the diamond structure[7], which appears to give the widest photonic bandgaps of all. But diamond structure is difficult to microfabricate. It requires three additional drilling directions in addition to those shown in the figure, all in the plane of the slab.



The method of constructing an f.c.c. lattice of nonspherical atoms. A slab of material is covered by a mask consisting of a triangular array of holes. Each hole is drilled through three times, at an angle 35.26° away from normal, and spread out 120° on the azimuth. The resulting criss-cross of holes below the surface of the slab, suggested by the cross-hatching shown here, produces a fully three-dimensionally periodic f.c.c. structure. The drilling can be done by a real drill bit for microwave work, or by reactive ion-etching to create an f.c.c. structure at optical wavelengths.

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