Comment on "Two-Dimensional Quasicrystals of Decagonal Order in One-Component Monolayer Films"

In a recent Letter, Patrykiejew and Sokołowski [1] studied the rich phase behavior of atomic monolayers on the (100) face of a face centered cubic crystal by Monte Carlo simulations. They found a nontrivial phase [cf. Fig. 3(a) in [1]], which they claim to be a two-dimensional quasicrystal with decagonal order. However, as we show in this Comment, the respective phase is periodic and does not have a tenfold rotational symmetry, therefore it is neither a quasicrystal nor decagonal.

In Figs. 3(a) and 3(b) of Ref. [1], Patrykiejew and Sokołowski present a phase observed in their simulations and assign to it a perfect tiling. In the literature (e.g., [2]), this tiling is known as Archimedean tiling (AT) of type (3^2.4.3.4). We illustrate it in Fig. 1(a). ATs are formed by regular polygons and are characterized by the number of edges of the polygons that meet in each vortex. In the tiling of Fig. 1(a) going around a vortex, one first finds two regular triangles, then a square, a regular triangle, and finally again a square. ATs are perfectly periodic and therefore the corresponding patterns are crystals and not quasicrystals. In Fig. 1(a) the unit cell of the (3^2.4.3.4) AT is drawn with bold lines.

The (3^2.4.3.4) AT possesses the crystallographic symmetry group $p4g$ (for notation, see [2]). It especially has fourfold and twofold rotational symmetry axes [see examples in Fig. 1(a)], but no decagonal symmetry. As shown in Fig. 1(b), the structure factor clearly does not reveal any tenfold symmetry.

In summary, Patrykiejew and Sokołowski observed a pattern corresponding to the (3^2.4.3.4) AT that has neither a quasicrystalline nor a decagonal symmetry.

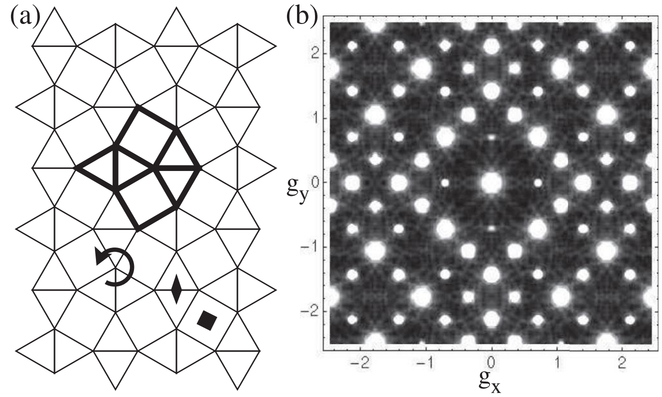

FIG. 1. (a) Archimedean tiling (AT) of type (3^2.4.3.4) corresponding to the pattern observed in [1], Figs. 3(a) and 3(b). The circular path is used to characterize the AT and the symbols ■ and ◆ represent examples for fourfold and twofold rotational symmetry axes, respectively. The unit cell is drawn with bold lines. (b) Structure factor of the corresponding point pattern.

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