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Periodic cubic <110> six-way cylinder packing structures

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Packing problems are an important aspect of crystallography. In particular, sphere packings have played an important role in improving our understanding of crystal structures. Cylinder packings are also important for the same reason and have been investigated in the fields of both science and engineering. In the field of science, the complex structure of garnet has been explained on the basis of cylinder packing to be a periodic structure with a cubic <111> four-way cylinder packing [1a]. In the field of engineering, cylinder packings are important for determining the fiber packings of composite materials. Some regular fiber packing structures have been designed. Motivated by structures of composite materials, periodic cubic <110> six-way cylinder packing structures have also been investigated [1b]. The known <110> six-way cylinder packings can be classified into three categories on the basis of packing density: $(\sqrt{2})\pi/9 \approx 0.494$ (Type-I), $(\sqrt{2})\pi/18 \approx 0.247$ (Type-II), and $(351\sqrt{2} + 108\sqrt{6})\pi/1936 \approx 0.376$ (Type-III). Recently, Teshima and Matsumoto studied the space group of the Type-III structure [2]. And Moore reported another type of periodic cubic <110> six-way cylinder packing structure (packing density ≈ 0.133) [3a,b]. In this study, authors consider a general description of periodic cubic <110> six-way cylinder packing structures.

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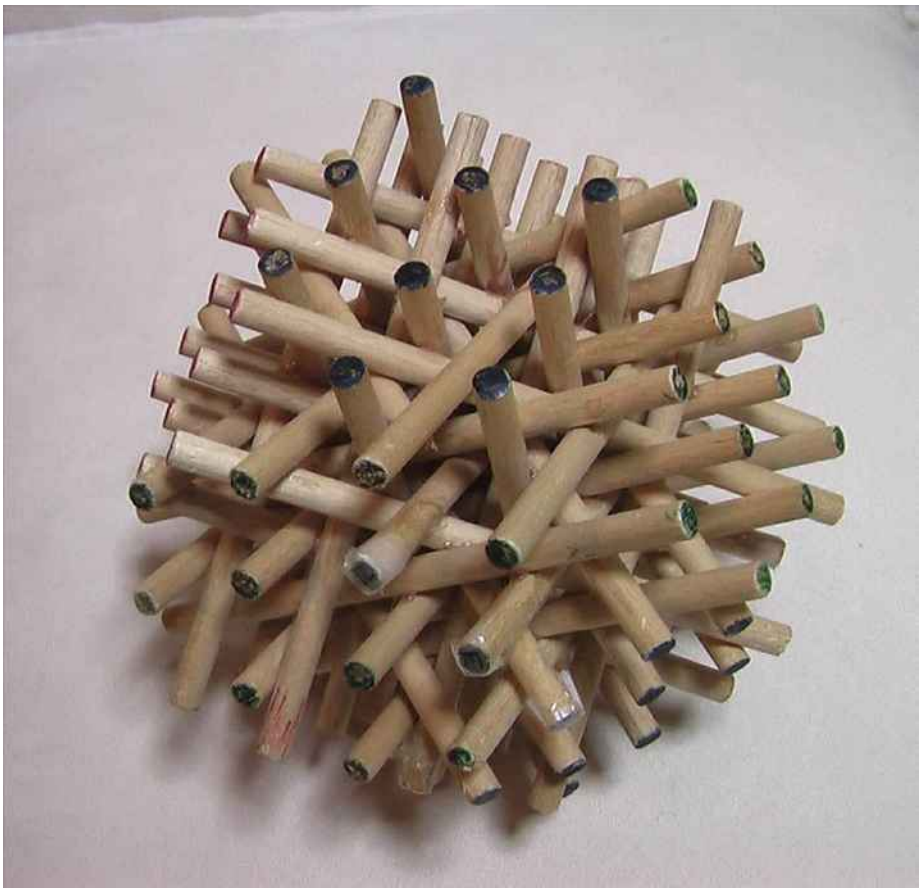

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