Sphere Packings with Exceptional Properties

Elke Koch, *Institut for Mineralogy, Petrology and Crystallography, University of Marburg, D-35083 Marburg, Germany.* E-mail: elke.koch@staff.uni-marburg.de

Homogeneous sphere packings with different kinds of unusual and strange properties are discussed.

For most sphere-packing types there exists a minimal density, and the corresponding sphere packings show the highest inherent symmetry of that type. In the other cases the density decreases towards a boundary of the parameter range. So far, three exceptions are known: in one case, the minimum of density refers to parameter values very close to but not identical with those of highest inherent symmetry; two sphere-packing types exist the minimal densities of which occur not only at a single point but at a whole line of its parameter region.

Normally, the small rings of spheres within a sphere packing are not linked. Very few examples, however, have been found where such rings are catenated. In such a case, a purely graph-theoretical characterization of the type is not sufficient [1].

Some sphere packings may be intertwined in such a way that 2, 3, 4, 5 or 8 congruent or enantiomorphic copies interpenetrate each other without mutual contact. For such interpenetrating packings the contact numbers per sphere vary between 3 and 6. In a few cases, sphere packings of the same type may be fitted into each other in different ways. In addition, interpenetrations of two-periodic 6^3 and 48^2 nets of spheres have been derived. Here the nets are arranged in two or three sets of parallel nets [2, 3] with a mutual angle of 90° or 60°, respectively.

[1] Koch E., Sowa H., *Acta Cryst*., 2004, A**60,** 239. [2] Fischer W., Koch E., *Acta Cryst*., 1976, A**32**, 225. [3] Sowa H., Koch E., *Acta Cryst.*, 2004, **A60,** 158.

Keywords: sphere packings, interpenetration, catenation