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Authentic-looking replicas made of polished marble dust:
The head of Hygeia, Greek goddess of health.

Picture in color and printing quality: www.fraunhofer.de/researchnews

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Treasures reborn out of dust

A day at a museum often forms part of vacationers' sightseeing plans. Greece has many famous sites of antiquity, where visitors can admire marble busts and statuary. It has become standard practice to protect the valuable, antique specimens against inquisitive fingers or polluted air by displaying almost indistinguishable, hand-made replicas. In a joint project with partners in Greece and England, the Fraunhofer Institute for Manufacturing Engineering and Applied Materials Research IFAM in Bremen has found a cost-effective method of mass-producing such replicas. As part of the EU-sponsored ECOMARBLE project, they investigated the viability of marble dust as a material for reproducing sculptural works.

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"The project involved two different tasks," relates Dirk Hennigs of the IFAM. "One was to produce exact replicas of original historical artifacts. The other was to manufacture marble objects for the mass market, using injection molding or a similar process." The first step in producing a replica is to record the precise three-dimensional geometrical data of the original specimen. This alone poses difficulties, because many specimens are too fragile to be touched, let alone transported. Our Greek partner, Geoanalysis, supplied the answer: digital photogrammetry. A transportable device takes non-contact measurements of the object and its contours, and automatically produces a three-dimensional computer model from this data.

"Using the model and our ProMetal® rapid-prototyping 3D printing process, we can build up a three-dimensional object, layer by layer," explains Hennigs. "This process is unique in Europe, and capable of processing practically any powdered material – including marble dust." The best results are obtained from powders with a particle size of between 50 and 100 micrometers. The binder hardens within about twelve hours. A minimal amount of grinding and polishing is required to finish off the product.

The powder injection-molding process, by contrast, was designed for mass production. The materials scientists discovered a mixture of dust and binding agents suitable for forming large volumes of small marble objects. The result: pocket-sized reproductions of the Acropolis or the Olympic Stadium in Athens, to be sold as souvenirs. "Geoanalysis is now implementing this technology with our support," says Hennigs. "With the next Olympic Games to be held in Greece, many visitors will want to take home such a piece of marble as a souvenir."