

Swiss researchers create unscratchable gold

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Credit: 2011 Hublot

(PhysOrg.com) -- EPFL scientists have created 18-karat gold that's harder than tempered steel and virtually unscratchable.

By combining a gold alloy with [boron carbide](#), an extremely hard ceramic that's used in bulletproof vests, a team of EPFL researchers has succeeded in making the world's toughest 18-karat gold (75% gold). With a Vickers hardness number of 1000, it's harder than most tempered steels (600 Vickers) and thus almost impossible to scratch, except with a diamond. This discovery is the result of a three-year collaboration between the Mechanical Metallurgy Laboratory in EPFL's Institute of Materials, under the leadership of Professor Andreas Mortensen, and the Swiss watchmaking company Hublot.

The process for developing this material is relatively complicated. Powdered boron carbide is heated to almost 2000°C, where it forms a

rigid, porous structure by a process called sintering. A liquid molten alloy of gold is infiltrated under very high pressure into the pores of this structure, and then solidified, yielding a pore-free composite material. The final material is thus made up of two kinds of crystals that are intimately interconnected in space, like two three-dimensional labyrinths. Because the molten gold used is a previously-made alloy based on 24-karat gold and aluminum (3%) for strength, the final gold is thus 3% aluminum, 75% gold and 22% boron carbide

By definition, gold is very soft. Managing to harden it to this degree while still maintaining 18-karat purity was a real challenge for the EPFL scientists. They overcame the obstacle by taking the ceramic-metal composite approach. Composite materials are created by artificially combining several materials that conserve their individual characteristics even after they're assembled. In this they are different from alloys, in which atoms mix together to form a new, homogeneous, material.

The EPFL researchers aren't the first to play around with different materials in an effort to make more resistant gold. They are, however, the first to have attained this degree of hardness in 18-karat gold. The first watches made using this new [gold](#) will be presented in 2012 at BaselWorld, the world watch and jewelry show.

Provided by Ecole Polytechnique Federale de Lausanne

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