Supporting Information

Selective growth of silver particles on the facets of synthetic diamond

B. B. Bokhonov[a,b], H. Kato[c]

[a]Institute of Solid State Chemistry and Mechanochemistry SB RAS, Kutateladze str. 18, Novosibirsk, 630128, Russia

[b]Novosibirsk State University, Pirogova str. 2, Novosibirsk, 630090, Russia

[c]Tohoku University, Institute for Material Research, Aoba Ku, 2-1-1 Katahira, Sendai, Miyagi 9808577, Japan

Experimental details

Synthetic diamonds 100 μm in size were purchased from Guangdong Shuangling Diamond and Tools Industry Pty.Ltd, China. Silver nitrate and oxalic acid were purchased from Sigma-Aldrich and used to obtain silver oxalate. All chemicals were used as-received without further purification. A silver powder consisting of particles 1-5 μm in size was obtained by thermal decomposition of silver oxalate at a temperature of 250 °C.

Annealing of the mixtures of the synthetic diamond crystals with the silver powder was conducted using the following procedure. The synthetic diamond crystals were mixed with the synthesized silver powder in an alumina container. The container was placed in a tube furnace, in which annealing of the mixture was conducted in atmospheres of air; or under flowing argon, argon-oxygen or argon-hydrogen gaseous mixtures. Depending on the aim of the experiment, the annealing temperature was varied from 600 to 900 °C. The annealing time was varied from several minutes to several hours. After annealing, free silver particles (not deposited to the surface of the diamond crystals) were removed by sieving the product of annealing through a sieve with a size of openings of 50 μm. In order to study the morphology of the surface of the diamond crystals after annealing with silver, the deposited silver particles were removed by treating the crystals in 20% nitric acid solution.

The morphology and the crystalline structure of the initial materials and synthesized heterostructures were characterized by Scanning Electron Microscopy (SEM) using a HITACHI S3400 microscope (Japan) and X-ray diffraction (XRD) using a D8 ADVANCE powder diffractometer (Bruker AXS, Germany). Thermogravimetry and mass-spectrometry were conducted using a thermoanalytical instrument equipped with a STA 449 F/1/1 JUPITER thermal analyzer and a QMS403 CF AEOLOS mass-spectrometer (Netzsch, Germany). The analyses were conducted in Ar+5%O_2 and pure argon atmospheres.

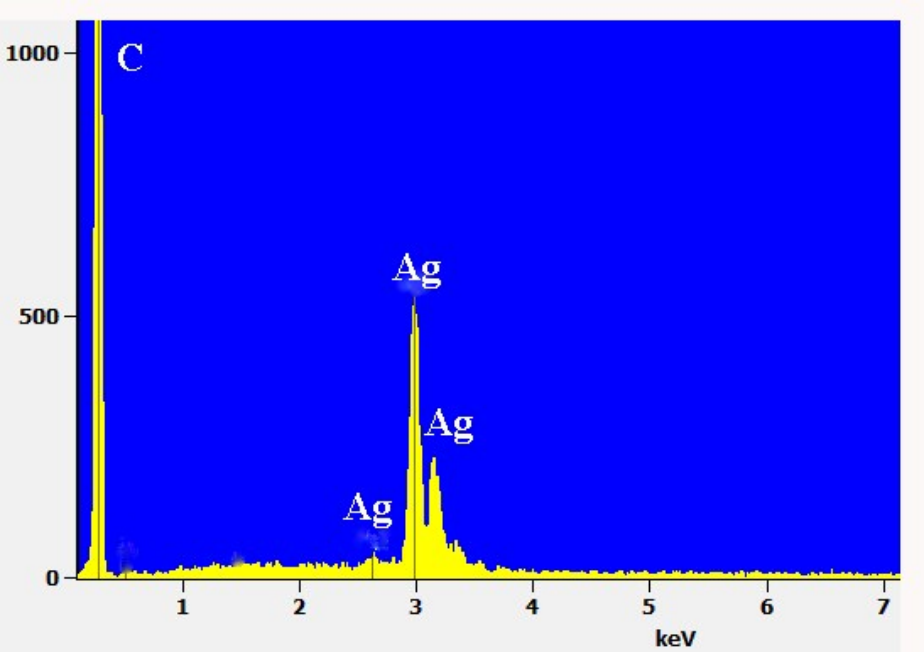

Figure S1. The EDS spectra of the heterostructures formed during annealing of the silver powder with diamond microcrystals in air at 700°C. The spectra contain lines of carbon and silver.

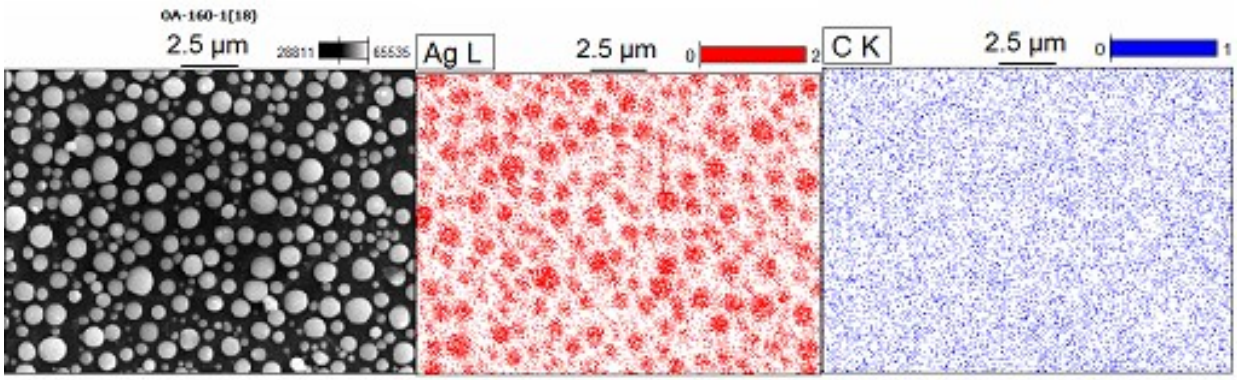

Figure S2. Elemental maps recorded to characterize the selective deposition of silver on a (100) diamond facet.

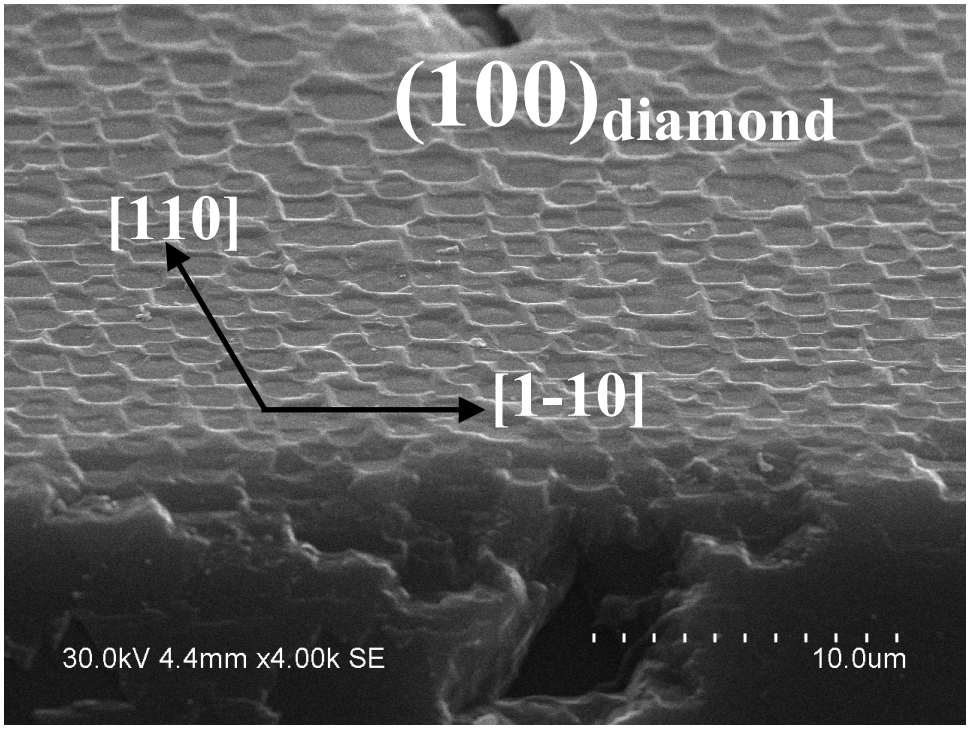

Figure S3. SEM image of a (100) facet of the diamond crystal of the silver- diamond heterostructure formed by annealing the mixture of powders in air at 700°C after treatment in nitric acid. The etch pits cover the (100) diamond facet.

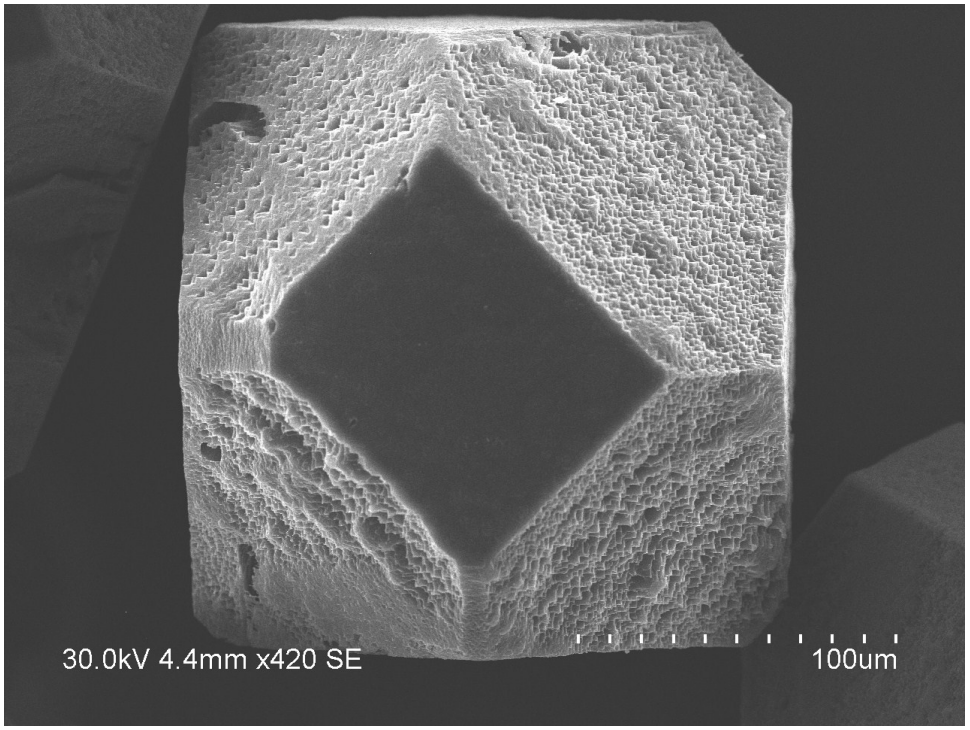

Figure S4. SEM image of the diamond crystals annealed in air at 750°C. Selective oxidative etching of the {111} facets and the formation of pyramidal etch pits are observed.

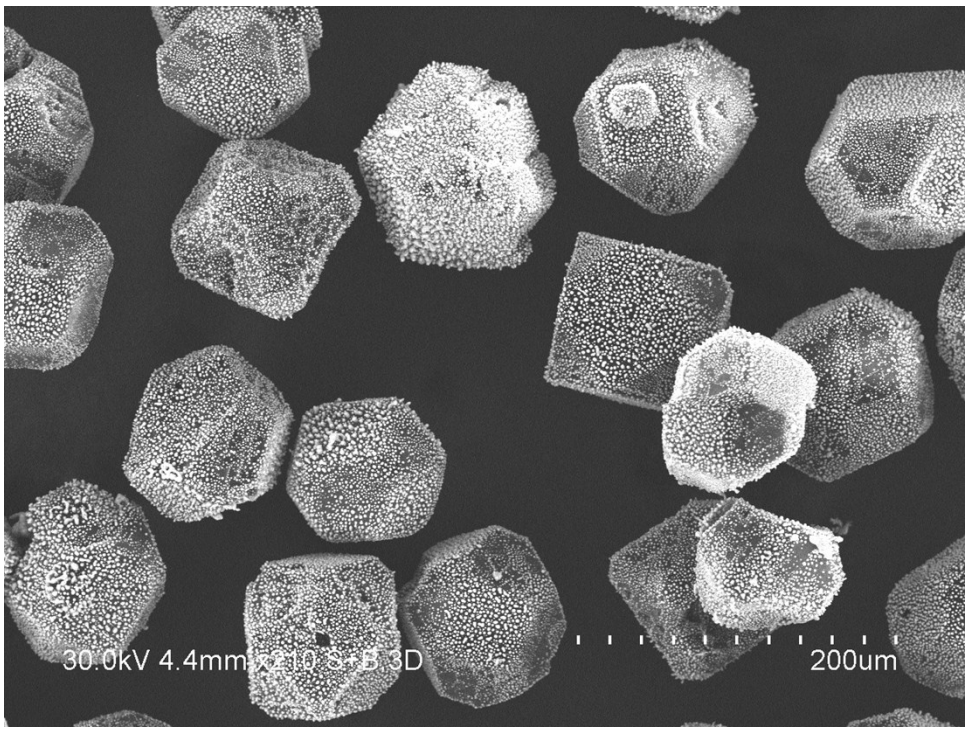

Figure S5. SEM images of Ag particles deposited on the diamond crystals subjected to preliminary oxidative etching at 750^{o}C before deposition of silver. All diamond crystals of truncated cube shape show Ag particles deposited on the {100} and {111} diamond planes.

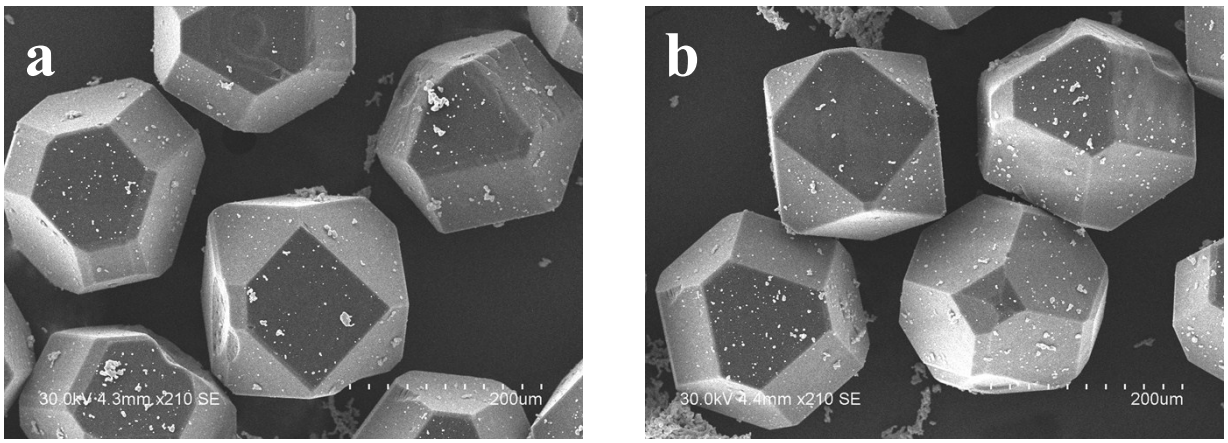

Figure S6. SEM images of the silver–diamond powder mixture annealed in a hydrogen (a) and argon (b) atmosphere at 750^{o}C. No particle growth is observed on any diamond facet.