Electronic supplementary information

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S1  The surface distribution of sp\(^2\)-BN is shown by the secondary ion mass spectrometry (SIMS) image reported in Figure S1. The ion image confirms that boron segregates and reacts with the dissociated anhydrous NH\(_3\) and essentially form BN nanophases that almost uniformly coat the stainless steel surface.

![BN image](image)

*Figure S1. Secondary ion \(^{11}\text{B}^{14}\text{N}\) image (HB doped AISI 316 stainless steel, microbeam Cs ion source, rastered area 0.15 x 0.15 mm). The maximum value for the colour scale corresponds to the most intense pixel in the SIMS ion image and is displayed on the left side.*

S2  Figure S2. XRD pattern for a HB stainless steel after thermal treatment carried out in a dissociated anhydrous NH\(_3\) atmosphere at 1070°C.

![XRD pattern](image)
Figure S2. XRD pattern for a HB stainless steel after the thermal treatment carried out in a dissociated anhydrous NH₃ atmosphere at 1070°C.

Secondary ion mass spectrometry (SIMS) characterisation was carried out on a Cameca 4f spectrometer using a microbeam caesium ion source rastered over an area of 0.15 x 0.15 mm and showing negative secondary ions. Secondary ion images were collected within a 24 x 24 μm area. The maximum value for the colour scale corresponds to the most intense pixel in the ion image and is displayed in the left-hand corner of the image.

X-ray diffraction (XRD) patterns were recorded directly on the AISI 316 samples by a Siemens 5000 X-ray powder diffractometer with Ni-filtered Cu Kα radiation (λ = 0.154056 nm). XRD patterns were recorded by adopting the following experimental conditions: 2θ angular values between 10° and 120° in additive mode; a step size of 0.05° 2θ and a sampling time of 20 s.

Further details on XPS measurements: photoelectron spectra were collected at a 20 eV constant pass energy of the analyser and a base pressure in the analysis chamber of 10⁻⁸ Pa. The binding energy (BE) scale was calibrated by measuring the C 1s peak (BE = 285.0 eV) from the surface contamination and Au 4f₇/₂ peak (BE = 84.0 eV) from sputter-cleaned Au 99.99% foil. XPS elemental quantitative analysis was determined for the surface of the materials and for each sputtering level by using a standard quantification routine including the evaluation of the attenuation length as a function of the electron kinetic energy, the measurements of the most intense core-level peak areas (B 1s, N 1s, C 1s, O 1s, Fe 2p, Ni 2p, Cr 2p) after smoothing performed over five points (polynomial cubic function) and subtraction of the X-ray satellite structure and of the "S" type integral back-ground profile (Shirley method) and the use of a standard set of sensitivity factors whose validity was already demonstrated in previous works²²,²⁹-³⁰. The XPS spectra were acquired and processed by the Casa XPS v. 2.2.84 software, using a peak-fitting routine with symmetrical Gaussian-Lorentzian functions. Elemental concentration depth profiles were obtained by alternating XPS measurements with Ar⁺ bombardment sequences. Argon ion etching was performed using a rastering differential pumping ion gun VG A61 operated at a pressure of 5 x 10⁻⁶ mbar (ion incidence angle 50° to the sample normal, estimated sputtering rate ≈ 0.2 nm/min).

Further details on FTIR measurements: A microscope Bruker Hyperion 3000 attached to an interferometer Bruker Equinox 55, a KBr beam-splitter, a Globar source and a mercury-cadmium-telluride detector were used with the microscope working in reflection mode at a spectral resolution of 4 cm⁻¹. AISI 316 steels coated with BN triangular nanoplates and reference spectra of areas of 170x170 μm² were collected averaging 50 interferograms; the AISI 316 steel substrate (not coated) was used to measure the reference spectrum.
Transmittance spectra were calculated, and a baseline correction was applied by OPUS 6.5 software.