Fabrication of hot magnetron carbon targets for a high-rate films deposition by using magnetron sputtering technique under the injection of neon-helium gas mixture

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A study of temperature of magnetron glassy carbon targets was performed for the case of gas injection magnetron sputtering (GIMS) of diamond–like carbon (DLC) and amorphous C–SiC films, by using unique geometry of the cathode source with increased temperature (HT – hot target). Cathode material was hollowed out for this purpose, from the bottom to the max. depth of 5 mm, which allowed to achieve target temperatures ranging from 790 to 1350 °C during the deposition of h-free carbon films. For the latter, four sockets were drilled in carbon target and then filled up with silicon carbide powder. In the second experiment, temporal evolution and spatial distribution of C–SiC cathode surface temperature were controlled by initiation of discrete pulse plasma discharges with power energies (E_i) changing from 122 to 403 J, which resulted in the temperature range from 730 to 1200 °C. The role of sputtering, sublimation and thermalized electrons in the increase of atoms removal from targets with limited heat conduction was clarified on the basis of an almost 4–fold increase in film deposition rate (up to 74 nm/min), compared to the completely cold process. For both variants of film deposition, GIMS were operated by generating as short as 400–ms and 250–ms plasma pulses at the frequencies of 1 and 2 Hz, respectively, thereby limiting the capability to cool targets operation over the neon–helium gas mixture. By contributing through the heat dissipation effect of HT, GIMS regime proved therefore to be an accurate in terms of increasing optical bandgap within DLC films, from 2.3 to 3.1 eV, which is derived from ordering of sp^2–graphene domains. The chemical and phase state of C–SiC films deposited from HT, revealed in turn, ~ 15 % of Si–C bonds, terminated in the 30 %–rich sp^3 carbon matrix, which puts its positive attribution to enhanced mechanical response, by means of 30.1 GPa hardness result.

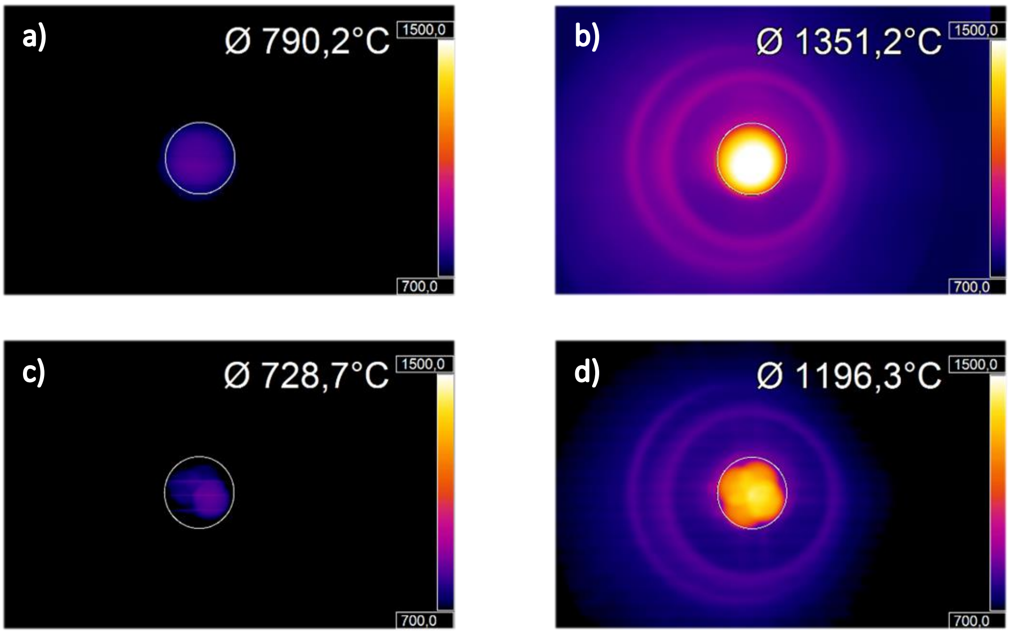

Fig. 1. IR-thermogram of the studied targets' surface with its corresponding mean temperature; a, c) cold carbon and C–SiC targets, b, d) hot carbon and C–SiC targets, respectively.

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