Avalanches of nanoexplosions of tungsten nanowires

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The dynamics of Joule energy release in helium-filled tungsten nanowires is considered on the basis of new conductivity estimations [Tsventoukh, Kulagin 2024 *Phys. Plasmas* 31 092509] taking into account electron scattering on an ensemble of helium nanobubbles. The minimum value of the current density was obtained, corresponding to the dominance of Joule heating over cooling by heat conduction. The minimum value was approximately 10 MA/cm^2. For a macroscopic spot, this value agrees with experimental observations and predicts the duration of explosive overheating in an ensemble of nanowires to be in the range of hundreds of nanoseconds.

It was shown that helium-filled single nanowire overheating time should be less than 10s of ps – id est faster than bubbles bursting time, which is annealing of nanowires. The corresponding current density is about 1 GA/cm^2. It provides energy release of about 10^{14} W/cm^3.

Fast (10s ps) explosion of nanowire results in massive release of helium, which flux to the neighboring nanowire can provide fast transfer of energy (comparable with value of 10^{14} W/cm^3) contributing to its explosion. Therefore, the exploding nanowires may 'interact' via large fluxes of He massively released from them, providing avalanche-like multiplication of explosions.

The hydrodynamic time for the formation of nanodroplets and exploding nanonecks from the remaining tungsten also occurs on the picosecond scale. This characteristic time is also related to the electron-phonon relaxation process, when the charge state observed experimentally is formed in an non-ideal plasma (see Tsventoukh 2021 *Phys. Plasmas* 28 024501).

This work was supported by RSF Grant No. 22-12-00274.