Laser acceleration of relativistic electrons in air.

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During supersonic expansion of compressed gases a gas-cluster medium is formed, in which, when irradiated with a laser pulse of relativistic intensity, a beam of electrons can be formed. From a thermodynamic analysis, conditions for creating clusters of optimal size were found. Radiation from a multi-terawatt TiSa laser with an intensity of up to $10^{18} - 10^{19} W/cm^2$ and a duration of 30 fs was used [1]. The cluster sizes varied from 3-5 to 50-70 nm, changing gases (N_2, O_2, Ar, Kr, CO_2) and pressures. Effective acceleration of electrons was obtained in nitrogen and oxygen clusters. Their 80/20 mixture and even compressed atmospheric air also are suitable for obtaining narrow, electron beam at plasma concentrations of $n_e \sim 2 - 5 \times 10^{19} cm^{-3}$. The best divergence (8 mrad) with sufficient charge (up to 50 pC) was obtained in gases with the lowest atomic number, with the smallest cluster size (in nitrogen, oxygen and air). Electron beam properties are consistent with a bubble or SM-LWFA acceleration regime [2]. At high pressure (and always in heavy gases), a high electron beam divergence is observed (100-200 mrad), this is consistent with the DLA mode. In optimal gases, a large (3 nC) charge is achieved. The spectrum in all cases is exponentially decreasing, with energy of 1-4 MeV. The results are relevant for obtaining betatron X-ray, bremsstrahlung gamma radiation and intense THz pulses from an electron bunch with a large charge and short duration.

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