Surface plasmon assisted room temperature Cooper pair formation in gold films

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A set of unique results of the study of nonlinear surface plasmon (SPP) phenomena are presented. The SPP-s have been excited in a gold film by intense femtosecond Ti:Sa laser pulses in the Kretschman geometry and spectra of SPP assisted electron emission have been measured by the time-of-flight (TOF) technique. Smooth and nanostructured gold films have been studied A set of these room temperature experimental observations is described. The TOF spectra show a high energy maximum, which is present only in a laser intensity range around 80 GW/cm^2. In addition to this high energy peak , intensive periodic narrow peaks have been detected on the top of the TOF spectra, copying the periodic oscillations of the plasmonic near field, but streched out in time by the ratio of the length of the flight path of the electrons and the height above the surface of the decay of the plasmonic near field,which is about one million , and so detecting femtosecond processes on the nanosecond scale .The plasmonic field enhancement effect in the structured sample is significantly higher, and so is the number of emitted electrons. Narrow periodic "resonances" have been found in the time-of-flight spectra of electrons with anomalies in the high energy peak, i.e. in the laser intensity range where electron pairing has been found earlier [1]. Significant differences have been found, however, in the nanostructured samples compared to those of the smooth surfaces. They are also more intense. In the laser intensity range, where the high energy peak is present, some of the (also periodic in time) but less frequent narrow peaks are about twice as large as the remaining ones, indicating the simultaneous detection of 2 electrons (Cooper pairs) within the resolution time of the TOF spectrometer. Detailed analysis of these findings is presented.

[1] N. Kroo et al., Physica Scripta 91 (2016) 053010.