# APROPOS THE ARTICLE "PHOTOSTIMULATED DIFFUSION IN SILICON" BY L.N. ZYUZ' ET AL. [1]

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Penetration of gold into silicon under the influence of light was reported in [1]. We attempted to repeat the experiments of [1] and obtained the following results: 1) If the layer-removal procedure used in [1] and duplicated by us is employed, radioactivity is registered even after etching 7 - 10 layers, regardless of whether the sample was illuminated or not. 2) The depth at which gold is observed ("depth of penetration") depends on the thickness of the removed layers: the thicker the layer, the larger the "depth of penetration." 3) The curves for the illuminated and control samples coincide if an identical etching procedure is used.

On the basis of our results, we analyzed the causes of the "penetration" of the gold into the silicon. We reached the conclusion that this penetration is illusory and is actually due to procedural shortcomings connected with the adsorption of the gold on the silicon during the etching process. It is known that gold is strongly adsorbed on silicon [2 - 4]. Experiment has shown that $10^{14}$ - $10^{13}$ gold atoms per cm$^2$ remain on a gold-coated silicon sample with a gold film even after repeated washing in boiling aqua regia[1)]. When such silicon is etched, some of the gold absorbed by the etchant becomes redeposited on the surface. Washing with aqua regia does not remove the deposited gold completely. The next etching again leaves a certain amount of gold on the sample, thus producing the false impression that the gold impurity penetrates into the material. It is easily seen that the depth of such a "penetration" should be smaller in the case of thin layers than in the case of thick ones, since the number of etching steps is larger in the former case, and with it the number of washings in aqua regia. This was indeed observed in our experiments.

The foregoing explains fully why a deeper "penetration" of gold into illuminated samples was observed in [1]. As seen from the figure given in [1], the layers etched off the samples were not of equal thickness. Layers ∿0.8 μ thick were removed from the illuminated samples and ∿0.14 μ from the control sample. This caused the apparent influence of light on the "penetration" of gold into the silicon.

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[1)]According to [1], the total amount of gold supposedly penetrating into the silicon as a result of the illumination is only about $10^{11}$ at/cm$^2$. It is therefore readily seen that even a megligible fraction of the impurity falling on the sample during the removal of the layers is capable of imitating the penetration of gold into silicon.

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## MAGNETOSONIC PLASMA HEATING IN A TOKAMAK

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In [1] we obtained experimentally for the first time excitation of magnetosonic resonance in a Tokamak plasma. We report here the results of experiments on magnetosonic plasma heating with the same setup ("TM-1-VCh").

As in the preceding experiments [1], the plasma was heated with a HF generator (f = 21 MHz) coupled to the plasma by a narrow loop. This loop was introduced into the liner either with or without quartz insulation. The discharge was produced in hydrogen or deuterium at a pressure $8 \times 10^{-5}$ - $8 \times 10^{-4}$ Torr.

The heating effect was determined by measuring the plasma pressure $n(T_e + T_i)$. The diamagnetic signal was determined from the reaction of the current in the circuit of the magnetic-field solenoid [2]. We measured simultaneously the average concentration of the charged particles with microwave interferometers at the wavelengths $\lambda$ = 3.8 and 7.9 mm. The diameter of the plasma column was estimated by microwave chord sounding.

The diamagnetism produced when an HF pulse is applied is illustrated in Fig. 1, which shows the increase of $n(T_e + T_i)$ and the increase of $T = T_e + T_i$ under the influence of the magnetosonic wave absorbed by the plasma. The HF pulse duration was 400 μsec and was chosen to agree with the estimated energy lifetime $\tau_E \sim 300$ μsec for heating by current. The average charged-particle density at the instant when the HF pulse was turned on was $10^{13}$ $cm^{-3}$ at an average plasma filament diameter 12 cm.

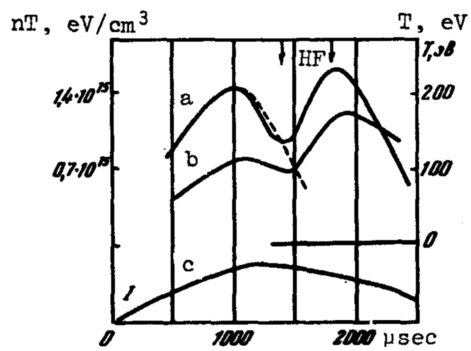


Fig. 1. a) Time variation of $n(T_e + T_i)$ in the presence (solid curve) and absence (dashed) of HF heating. b) Time variation of $(T_e + T_i)$. c) Oscillogram of current in plasma.

The energy content of the plasma in the Joule heating regime was 6 J in our experiment, the dissipation of the magnetosonic wave supplied more than 5 J to the plasma, and the total temperature doubled to approximately 200 eV. This effect corresponds to absorption of ~16 J of generator power ($P_{act} \simeq 40$ kW). The heating efficiency was thus 40%.

One of the most important problems connected with plasma heating is which of the particles, i.e., electrons or ions, absorb the energy of the magnetosonic oscillations. In our case, the ion temperature was determined by measuring the half-width of the C III impurity line ($\lambda$ = 4647 Å). The maximum ion temperature was reached in this experiment at the end of the HF pulse and amounted to ~110 eV. According to [5], this value of $T_i$ is an underestimate, since the C III lines are intense in the peripheral parts of the plasma filament.