**ELECTROMAGNETIC SCRAPE OF METEORITES AND PROBABLY COLUMBIA TILES**. Földi T.[1], Bérczi Sz.[2], [1] GEMINILUX, H-1117 Budapest, Irinyi J. u. 36/b. Hungary, [2] Eötvös University, Dept. G. Physics, Cosmic Materials Space Research Group, H-1117 Budapest, Pázmány Péter s. 1/a, Hungary. (bercziszani@ludens.elte.hu).

**Introduction**:

Any moving outerspace surface affected by solar radiation or solar wind may behave as cathode-anode system if it interact with the thin plasma. On the basis of experiments and observations in a) high vacuum transmitting (power) tubes, and in b) AC-DC tubes with Hg-vapour medium: we made two models about the transports in the thin plasma flowing around the outerspace surface. We concluded that material transports may cause various effects from the destructive cavity formations and material loss of the surface till the rebuilding (reshaping) the surface, depending on the pressure in the thin plasma. Both models conclude the material loss of the surface, but the mechanism of this process is slightly different in the two models.

**Anode loss in high vacuum transmitting (power) tubes:**

High vacuum tubes are filled with remnant air with $10^{-6}$ Hgmm pressure. As a consequence of this low pressure the free-path distance for electrons is longer then the size of the transmitting tube. In these conditions electrons can reach from cathode to anode without collisions. It has been frequently observed in these high vacuum transmitting (power) tubes that the anode looses material and after some 1000 hour continuous operation when the vacuum becomes lower degrre because of the emitted gases and metal particles. The surface of the anode becomes pitted, cavitated, spongy like structured. This observation was explained in the following way. The accelerated electrons coming from the cathode will not uniformly impact the anode but they "distinguish" some spots on the surface of the anode and they prefer to impact in these spots. These spots have random distribution on the surface of the anode. (Probably the inner crystal structure of the anode metal is not uniform enough for the equipotential effects.) Long time use of these spots cause the scraping of these spots on the anode surface which finally show a kind of cavity-like character [1,2].

**Application of the model of anode loss in high vacuum transmitting (power) tube to outerspace surfaces with thin plasma**:

Outer electric generating effects (solar gamma, X-ray and UV radiation together with other corpuscular partricles of the solar wind) are bombarding the orbiting surfaces. These radiations and corpuscular sources deliver enough energy for outerspace surface (meteorite, shuttle tile) that some electrons escape, leaving extra positive charge on the surface. Because of the gradually increasing charge a very high (some 100 V up to 100 kV) electrostatic potential is generated on the surface in this process. Such charged surface acts as a cathode-anode system [2,3]. The charged surface attracts dust particles and negatively charged ions so forming an ion-plus-dust cloud surrounding surface. This cloud can be considered as a thin plasma which flows around the surface. In this case the surface of the charged outerspace object can be divided to spots with anode and spots with cathode character. The side lighted by the sun is the cathode, and the side in shadow is the anode, but these regions alternately change according to the position of the outerspace object. The loss of material occurs on the surfaces which behave as anodes.

**Anode loss in AC-DC tubes with Hg-vapour medium**:

In AC-DC tubes with Hg-vapour medium the pressure of the Hg-gas is some 0.1 Hgmm. In this pressure the free path distance for electrons is shorter then the size of the tube, therefore the electrons may collide each other on their way from the cathode to the anode. As a consequence of this parameter the gas filling of the tube is divided to two parts. In one region, near to the anode (named positive column) the gas is lighting because of the ion-recombination. The other side of the gas holds an electron ray without collisions: this region is in front of the cathode and it is dark. The corresponding sites in the cosmic object are the following: The surface lighted by the Sun is the cathode. The other part of the outerspace object which is in the shadow, is the anode. They are "connected" by the thin plasma which surrounds the outerspace object (surface).

**Application of the model of anode loss in AC-DC tubes with Hg-vapour medium to outerspace surfaces with thin plasma**:

Electrogasdynamic effect with magnetic force may cause spots of decreasing thickness on surfaces in contact with thin plasmas. The moving outerspace surface affected by solar radiation or solar wind interact with the thin plasma, and a boundary layer appears between the surface and the plasma. The thin plasma contains strong nonlinearities (Electron-ion density, nonequilibrium ionisation, magnetic wall effects, etc.). This implies that during the interaction between the surface and thin plasma great frequency currents are induced together with the direct currents inside the plasma. As a consequence of this interaction the surface becomes semiconductor. Depending on the locality of the outer radiation pn and np transitions appear along the surface. One of them plays the role of the cathode, the orther does that of the anode in the plasma stream. If the outerspace surface rotates, then the pn and np transition zones move along the surface depending on the direction of the irradiation. From the nonlinearity of the thin plasma it follows that this movements of pn and np transition belts are nonuniform but it produces jumpings. On some distinguished portion of the surface the pn or np transition may be longer period then that coming from a rotation.

**Another type descrition of the transport process in cathode-anode system on the surface:**

In another approximation the system of irradiated surface and thin plasma can be compared to Faraday's electrolysis. One of the irradiated surface is the cathode, emitting electrons. The transporting fluid can be corresponded to the thin plasma. The anode is the point where the electrons impact. This anode spot is heated up (the anode spot is lighting) by the negative ion and electron impacts and ions are emitted from this anode spot. (Probably this lighting contributes to the glow seen around shuttle during orbit.) However, the ions rising from this anode spot will not surely find "landing site" on the surface because the following reasons. 1) the tube of the rising ions does not exist because the magnetic field of the plasma is not strong enough, 2) the tube of the rising ions does exist but can not reach the surface because of the motion (rotation) of the surface, 3) the rising ions are recombined in the near vicinity of the anode spot and they will be lost for the surface system. This last case results in the direct loss (scrape) of mass of the surface.

*a) Cavity formation (material loss effect)*

How does the charged surface interact with a thin plasma with positive ions? The charged surface pushes positive iones but attracts the large negative ions. Impacts of the large negative ions or dust particles may cause the ioncavity effect [4] in the following way. If the flux of the impacting ions or dust particles is large enough, then the self magnetic force field of this stream comprimes the ion-stream and causes expressed micro-cavities on the surface. (Probably the hyperboloidic local surfaces are the bowl shaped cavities on meteorites**. In the case of anode scraping the strong electric current plays important role, however, in the case of outerspace surfaces time is the important factor).**

*b) Reshaping effect (material gain effect)*

There is another case when the emitted ions form a transport tube which reaches the surface in another point. In this case the emitted ions "land on the surface" in recombined form and build the surface system in this another region. This kind of arrangement of the transport may reshape of the outerspace surface. We suggested earlier that the joint cavity+reshaping mechanism forms the characteristic negative-positive relief pattern of meteorite surfaces [1,2].

**Conclusions**:

Solar radiations are bombarding orbiting surfaces. These radiations deliver enough energy for outer surface that some electrons escape, leaving extra positive charge on the surface. Such charged surface acts as a cathode-anode system. If thin plasma flows around the surface, ion transport begins in the cathode/anode system. In this transport the large negative ions (or dust particles) impact in anode spots and may cause the loss of material of the surface and may form its cavities. This process probably affected the Columbia tiles, too, causing its material loss.

**References:**

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