Physical Process of Formation of Electric Charge by Friction of Bodies

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Abstract. This article describes the physical phenomena leading to the formation of an electronic charge and hole charge in two bodies upon friction.

1 Formation of Electric Charge at Friction of two Dielectric Bodies

At friction of two different dielectric bodies there is a collision of orbital electrons of atoms of a rubbing surface of one body, to nucleuses of atoms of a rubbing surface of other body. If one body have more massive nucleuses of atoms than other body, then the orbital electrons of atoms of this body have a greater radius of last orbit of electrons and consequently these orbital electrons have a greater opportunity of collisions with nucleuses of atoms of other body. At these collisions the orbital electrons reduce the velocity of motion and are released, i.e. there occurs an ionization of atoms. At these collisions of the orbital electrons with the nucleuses of atoms occurs also an etherization of the nucleuses.

Thus, at friction of two different bodies there occurs an ionization of atoms of a rubbing surface of the body having more massive nucleuses of atoms and occurs a deetherization atoms of other body having less massive nucleuses of atoms. Usually, the bodies having more massive nucleuses of atoms, has a greater specific gravity.

The released electrons move to all sides between rubbing bodies, but cannot enter into the dielectric bodies, therefore they remain in the superficial layer of bodies or above of the surface of body. At electrization of a thin dielectric body, the free electrons can to pass through this body and to remain above both surfaces of this thin body.

As at friction of two bodies from a body, which have a greater relative density than other body, leave the released electrons, then after separation

of these bodies in the rubbed surface of one body there is a lack of orbital electrons, and above the rubbed surface of both bodies there is an electronic plasma. In body, which have a hole charge, occurs a slow filling of holes of electronic orbits by electrons from electronic plasma. If a body with electronic plasma to shift in air with enough big velocity, then the electronic plasma can be separated from the body and remain in air separately from the body.

If electronic plasma above the surface of a body is enough big, then the electrons of this plasma have a big velocity of motion and at collision with nucleuses of atoms of the surface of the body can to deetherize these nucleuses of atoms. Thus, as a result of friction of two bodies occurs a deetherization of atoms of a rubbing surface not only one body, but also other body, but the measure of deetherization of these bodies can be different. The deetherized nucleuses of atoms form above the deetherized surfaces of bodies an electric field.

Absence of orbital electrons of atoms is called *orbital holes*, and a multitude of orbital holes is called *orbital hole charge*. Lack free electrons is called *hole charge*, or a *positive charge*. Surplus of free electrons is called *electronic charge*, or a *negative charge*. The external electronic charge is called *electronic plasma*.

If one of rubbed dielectric bodies has a small density (paralone, a paper), the released electrons of the more dense body enter into other body and there occurs an impact ionization of atoms inside of this body. The released electrons are moving in all sides and at collision with the dense body remain above its surface.

If one of two rubbing dielectric bodies to connect to a conductor, then the dielectric body which is connected to the conductor, will have a hole charge, because the released electrons on the surface of this body will pass in the conductor.

Coulomb is accepted as a unit of charge, which equals $6.25 \cdot 10^{18}$ electrons or electronic holes. The charge of a body is denoted by Q and defined as

$$Q = e \cdot n$$

where e denotes the electron and n is the number of electrons or holes in the charge.

2 Formation of Electric Charge in Conductive Body at Friction with an Dielectric Body

At friction of conductive bodies with dielectric bodies, the conductive bodies in most cases have a hole charge, and dielectric bodies have an electronic charge. Explanation of that, the nucleuses of atoms of conductive bodies in most cases have a greater mass than the nucleuses of atoms of dielectric bodies, due to that, the ionization of atoms can occur in most cases in a conductive body.

As a result of electrization by friction of a conductive body with a dielectric body, in the rubbed superficial layer of the conductive body are having an orbital holes, which form a superficial orbital hole charge. The released electrons from the conductive bodies pass a part to a surface of a dielectric body, and other part released electrons fill orbital holes of the polished surface conductive bodies. Thus, at friction of copper with linoleum, copper is electrized to be with hole charge, and linoleum electrized to be with electronic charge.

But if to rub a conductive bodies with glass then the conductive bodies have an insignificant electronic charge, and the glass has an insignificant orbital hole charge. It speaks that, that the conductive bodies and glass consist of atoms, the nucleuses of which have almost identical rather big mass, and because of that, the ionization of these nucleuses is insignificant.

If to rub a conductive body with a porolone, then the conductive body have a electronic charge, and the porolone body has an orbital hole charge. Explanation of that, that the porolone has very small density, and due to that, the released orbital electrons from the rubbing surface of the conductive body are entering not only in the conductive body, but also in the porolone. These electrons, at motion in the paralone have a greater velocity than in metals and in air, because in the paralone there are big vacuum cells and thin material partitions between them. At collisions of the electrons with the nucleuses of atoms of the material partitions occurs a impact ionization of these atoms, i.e. are released the orbital electrons of the greatest orbit of atoms of the paralone. Because of absence of the orbital electrons of the last orbit of atoms of porolone, these atoms approach with each other, why the porolone is decreased in volume almost half. The released orbital electrons move from the paralone in all sides and at transition in the conductive body remain there. Thus in the conductive body is formed an internal electronic charge, and the surplus of the free electrons forms an external electronic

charge in the form of an electronic plasma.

The free electrons of the internal electronic charge, having reached a surface of the body, do not leave this body, because on the surface of the body there is the superficial nuclear field which pushes these electrons back inside of the body. The greatest internal electronic charge in a conductive body is defined by size of this body and of strength of superficial nuclear field, which pushes the free electrons back inside of the body.

If an copper tube to rub with with paralone, then the copper tube will have an internal electronic charge with an external electronic plasma. If the copper tube to bring closer to a non-electrized conductor so that this conductor is being in the electronic plasma and if this conductor is connected to the "earth" through a measuring device, then it is possible to be convinced that the electronic plasma will leave in "earth" and in the copper tube are remained the internal electronic charge. And if next the conductor to approach to the copper tube to contact with him, then the electrons of the electronic charge also will pass in the "earth". But at passing of the electric current occurs an ionization of atoms of the copper tube and of the conductor, and herewith the released electrons are passing in the "earth". Therefore, if in some minutes this copper tube again to connect to the "earth", the measuring device will show a current in the opposite direction, i.e. occurs a transition of electrons from "earth" in the copper tube. It speaks that, that within these several minutes there was a filling of orbital holes by the free electrons, why in the copper tube was formed an lack of free electrons, and at connection with "the earth" this lack was filled.

Conductive bodies at friction with each other do not electrized, because the released electrons though pass from one body in other body, but they come in both bodies to proportionally their specific electric resistance, as a result the electrons appear in each body in the same quantity in what they were prior to the beginning of friction of the bodies.

3 Electric Charge of Different Bodies at their Electrization by Friction

Table 1 shows the results of charge measurements of various bodies after electrization by friction. The value of the charge of bodies is measured at non-standard unit of a charge.

Symbols of type of charge:

holes - a hole charge,
internal - an internal electronic charge,
surface - a superficial electronic charge,
orbit - an orbital hole charge,
external - an external electronic charge.

The electronic charge and hole charge of bodies gradually pass in "earth" through the surface of bodies. In conductive body remains a normal concentration of free electrons then when will by a identical resistance of motion of electrons in the given conductor and in "earth".

Conclusions

1. At friction of two different bodies occurs a collision of orbital electrons of atoms of one body with nucleuses of atoms of other body. At this collision occurs a release of the orbital electrons, i.e. occurs an ionization of atoms.

2. Ionization of atoms occurs in a body which consist of atoms having more massive nucleuses and accordingly having a greater radius of last electronic orbit.

3. As the electronic charge cannot enter into a dielectric body, then this charge remains above the rubbed surface of this body in the form of electronic plasma.

4. The hole charge of a dielectric body represents itself an orbital holes in the rubbed superficial layer of this body.

5.The electronic charge of conductive bodies represents itself an internal electronic charge and an external electronic charge in the form of electronic plasma.

First body	Magnitude and sign of charge	Type of charge	Second body	Magnitude and sign of charge	Type of charge
copper	+0.8	hol+orb	org. glass	−0.3	surf
copper	+1.5	hol+orb	plastic	−0.5	surf
copper	+12	hol+orb	linoleum	−1.8	surf+ext
copper	−5	int+ext	porolone	+3	hol
copper	−1.2	int+ext	glass	+0.2	hol
copper	+8	hol+orb	paper	0	—
copper	+0.3	hol+orb	rubber	0	—
copper	+1	hol+orb	acrylate	0	—
copper	0	—	steel	0	—
steel	+0.5	hol+orb	org. glass	−0.3	surf
steel	+0.5	hol+orb	plastic	−0.5	surf
steel	+5	hol+orb	linoleum	−1	surf+ext
steel	−5	int+ext	porolone	+1	hol
steel	−0.1	int+ext	glass	+0.1	hol
steel	+3	hol+orb	paper	0	—
steel	+0.1	hol+orb	rubber	0	—
steel	1.5	hol+orb	acrylate	0	—
paper	+0.1	orb	plastic	−1	surf+ext
paper	+0.5	orb	org. glass	−3	surf+ext
paper	+0.3	orb	porolone	−0.05	surf
paper	+0.1	orb	linoleum	−0.5	surf
paper	+0	orb	rubber	+0.05	hol
paper	+0.1	—	acrylate	−1.5	surf+ext
paper	−0.1	ext	glass	+0.2	hol
porolone	+5	orb	plastic	−3	surf+ext
porolone	+5	orb	linoleum	−8	surf+ext
porolone	+15	orb	acrylate	−15	surf+ext
porolone	+1.3	orb	glass	−1	surf+ext
porolone	+7	orb	rubber	−3	surf+ext
porolone	+2	orb	org. glass	−3	surf+ext
rubber	+1.5	orb	org. glass	−1	surf+ext
rubber	+5	orb	linoleum	−5	surf+ext
rubber	+1.2	orb	plastic	−1	surf+ext
rubber	0	—	glass	0	—
glass	+0.3	orb	linoleum	−0.3	surf
glass	+0.5	orb	plastic.	−0.2	surf

Table 1: Charge of Electrized Bodies