

Electromagnetic Pulse Source Using Fluidized Electrons

by

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Appendix I

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Fig. 1 EVO Strike with Skipping on Anode in Xenon Flash Tube Powered by Piezoelectric Generator.

A piezoelectric pulse generator, taken from a cigarette lighter, is used to power a xenon flash tube. The EVO is seen coming from the cathode on the left side of this optical photo and landing with a skipping action on the right side where the anode wire is located. The inductance of the lead wire is too high for an immediate dump of EVO energy resulting in a cyclic process for the energy transfer.

Photo taken using a macro lens on the camera and 35 mm film. The dimension of the photo from left to right side is approximately 0.01 inches.

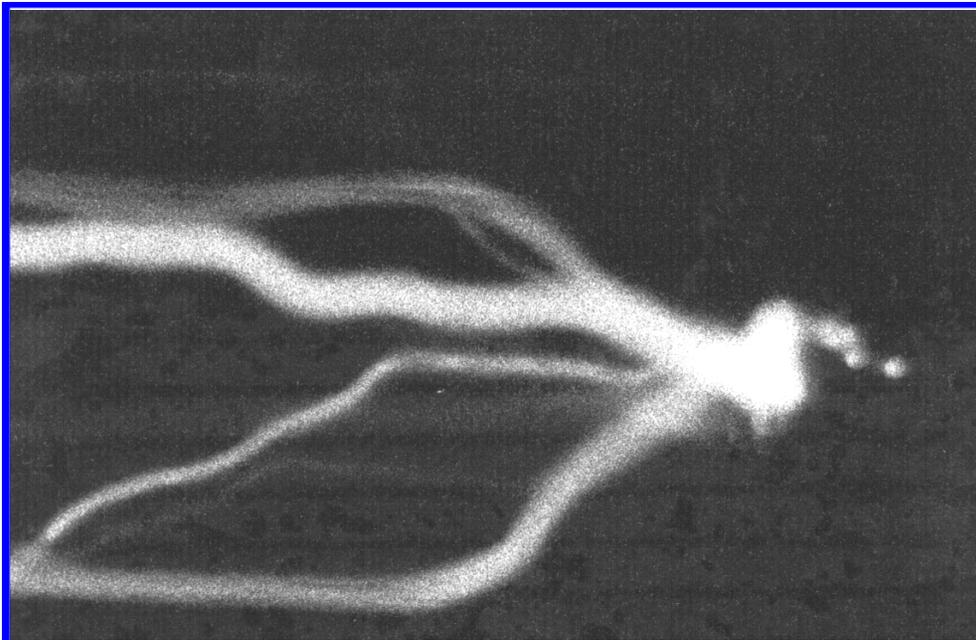


Fig. 2 Multiple EVO Strikes with Skipping on Anode in Xenon Flash Tube Powered by Piezoelectric Generator.

This view is similar to Fig. 1 with the exception of multiple smaller EVOs arriving that do not skip on the anode. Only the largest strike seems to skip. This is largely due to the increased charge induced in the electrode resulting in a greater voltage swing on the anode causing rejection of the approaching EVO after the first strike.



Fig. 3 SEM of EVO Skipping Across Film of Aluminum on Glass.

An EVO is seen coming in from the top of the photo in this scanning electron micrograph and breaking up as it proceeds across a thin aluminum film. There is a distinct hopping action seen as the EVO progresses. A split then occurs as the breakup proceeds and some branches die completely.

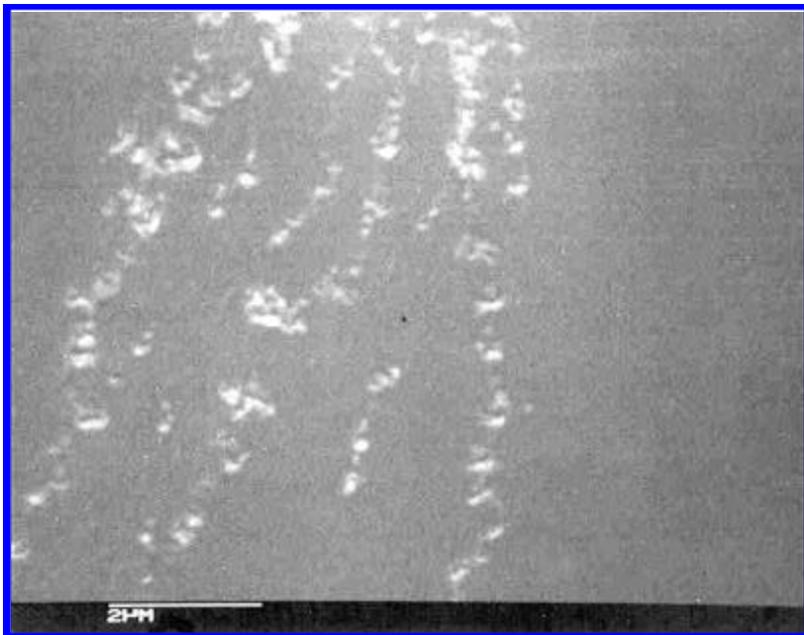


Fig. 4 SEM Magnified View of EVO Breakup.

This view is an extension of the lower portion of Fig. 3 taken at higher magnification to more clearly depict the interaction with the aluminum film coating on the glass substrate. Pits in the aluminum can be seen as the EVO tumbles and hops over the surface.

Such erratic motion causes intense electromagnetic radiation in the sub millimeter portion of the spectrum as the EVO is moving at approximately 1/10 the velocity of light.



Fig. 5 Pinhole Camera Side View of Dual EVO Flight Through Vacuum.

Coming from the EVO source at the lower portion of the pinhole camera image, the EVO is seen to follow a helical pattern of motion and decomposing into individual electrons as it moves at a rate of $1/10$ the velocity of light to the top of the photo. The length of the EVO run in this photo is approximately 0.1 inches.

This type of charge motion produces a chirped spectrum of radiation sweeping from higher to lower frequencies.



Fig. 6 Pinhole Camera End View of EVO Flight Showing Somewhat Regular Instabilities in Vacuum Flight and a Thrusting Type of Propulsion.

The EVO source is located in the center of the photo and the EVO flight is directly into the pinhole camera showing a kinky, spiraling motion. The turn radius is smaller than can be accurately measured in this photo but is in the order of a few micrometers giving a turning time of a fraction of a picosecond.

The deflection energy source is certainly located within the EVO itself and does not come from externally applied potentials due to the short-time deflection requirements. This resultant motion gives rise to a wide emission spectrum.

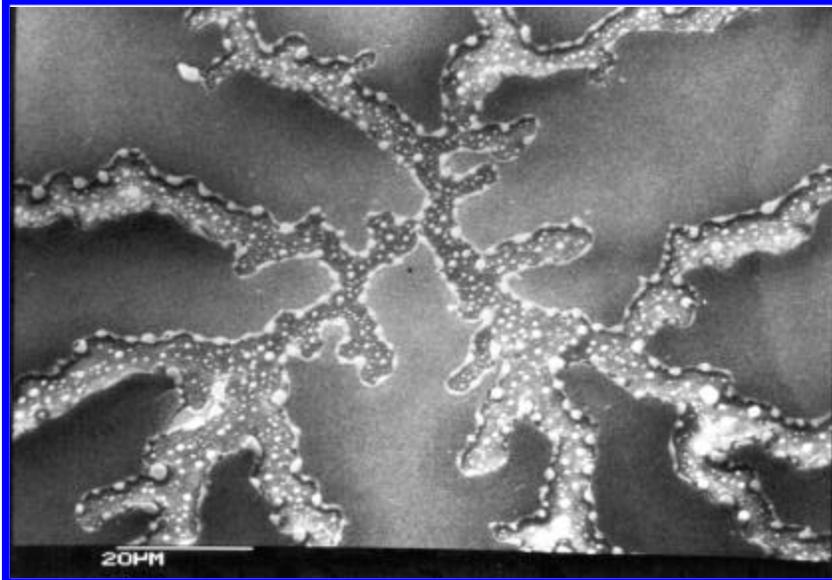


Fig. 7 SEM of EVO Launching Source From Chromium Film Deposited on a Glass Substrate.

This unique diagnostic technique shows that electrons flow toward the center launching point where the EVO departed into a low pressure gas environment and on to the anode. The electron flow direction can be seen due to the momentum imparted to the fluidized chromium that moved inward instead of outward on each of the current feed branches. The thinned region of convergence at the center is where the EVO lifted off the surface for the anode flight.

Without the use of a high resistance chromium film, this effect cannot be seen.

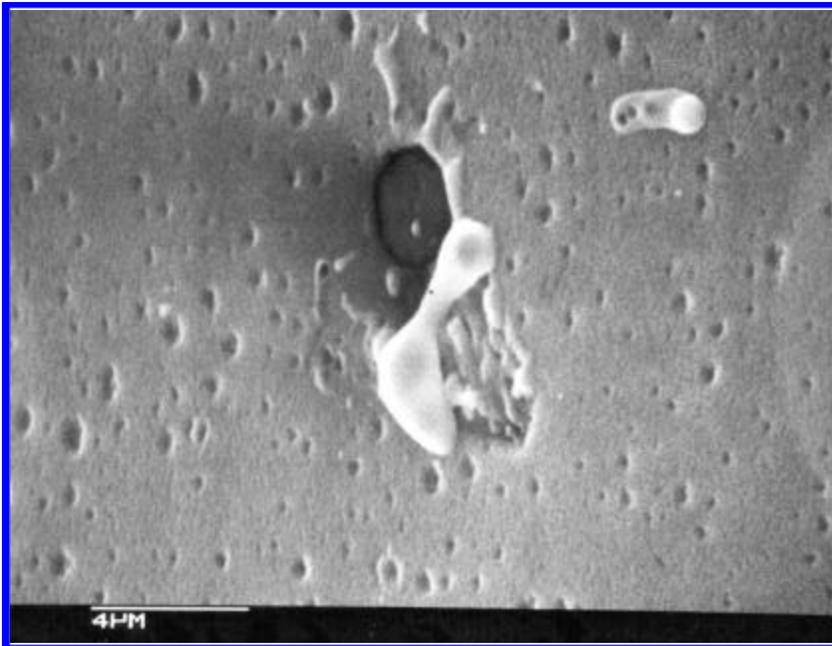


Fig. 8 SEM of EVO Strike on a Chromium Coated Glass Substrate Used as an Anode Target.

This photo is the anode of the cathode shown in Fig. 7. What is evident here is that the EVO arrived from the left side of the photo and moved toward the right as it skipped along the surface taking some chromium film with it.

The dark streak on the left is actual and is apparently caused by the approaching EVO modifying the chromium as it skims the surface looking for a landing spot.

This data further reinforces the notion that EVOs do not necessarily stop completely upon first contact with an anode. There are many motional aspects to them leading to diverse radiation patterns.

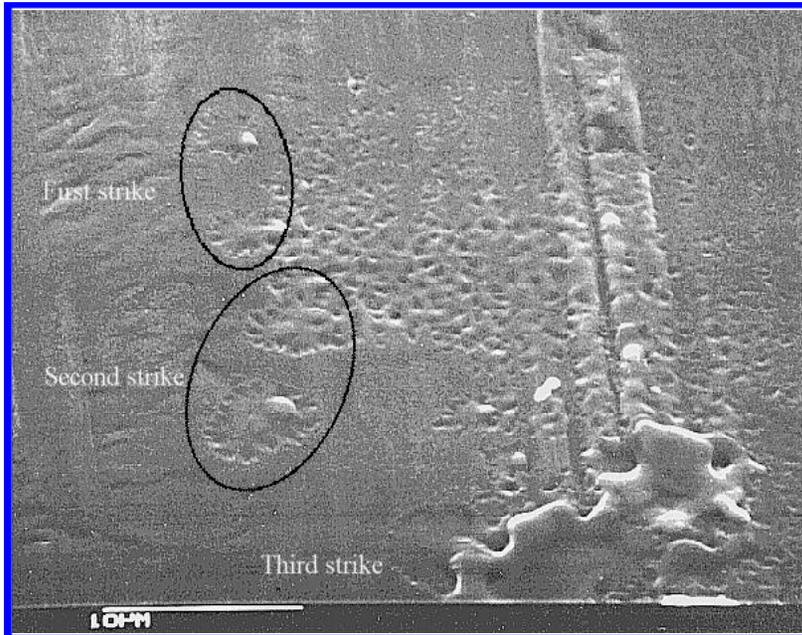


Fig. 9 SEM of Dual, Hopping EVOs Attempting a Landing on an Anode.

Three strikes of the same dual EVO are seen here while attempting a landing on an anode. The circles drawn around each attempt is shown in the photo. Due to the somewhat rare occurrence of dual EVOs, it can be surmised that the strikes seen are due to the same dual EVO lightly skipping over the surface before a final strong impact. This is the reverse order from what was shown in earlier figures where the most energetic strike came first.

The direction of EVO travel can be determined by the direction of the motion imparted to the fluidized material in strike # 4 shown in Fig. 10.

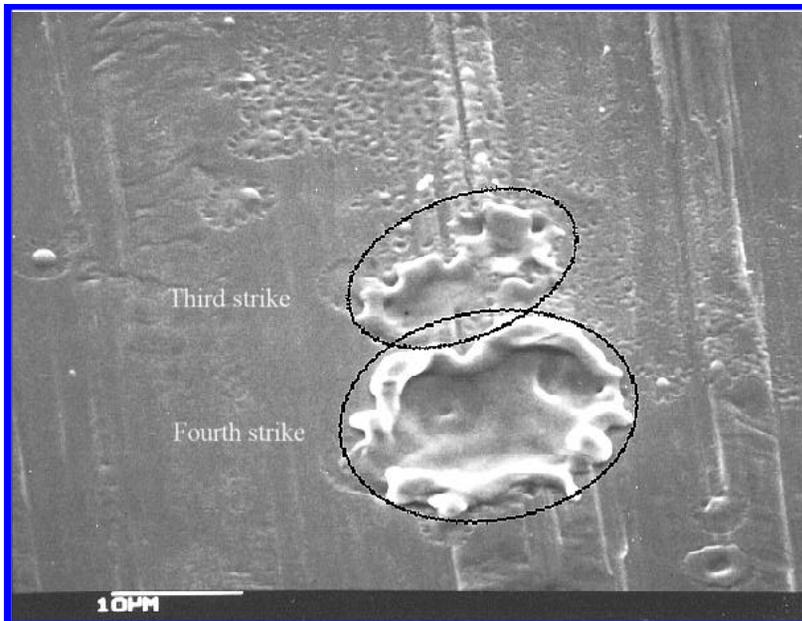


Fig. 10 SEM of Third and Fourth Dual EVO Strike on an Anode.

As an extension of Fig. 9, this SEM photo shows the third and then final fourth strike on an anode. It can be said with some assurance that EVO landings are multiple events leading to a spectrum stretched toward lower frequencies instead of depositing all of their energy in the x-ray and optical end of the spectrum.

This low frequency energy burst leads to greater damage to electronic devices although it does not transmit through shielded structures as well as short wavelength, photon radiation.

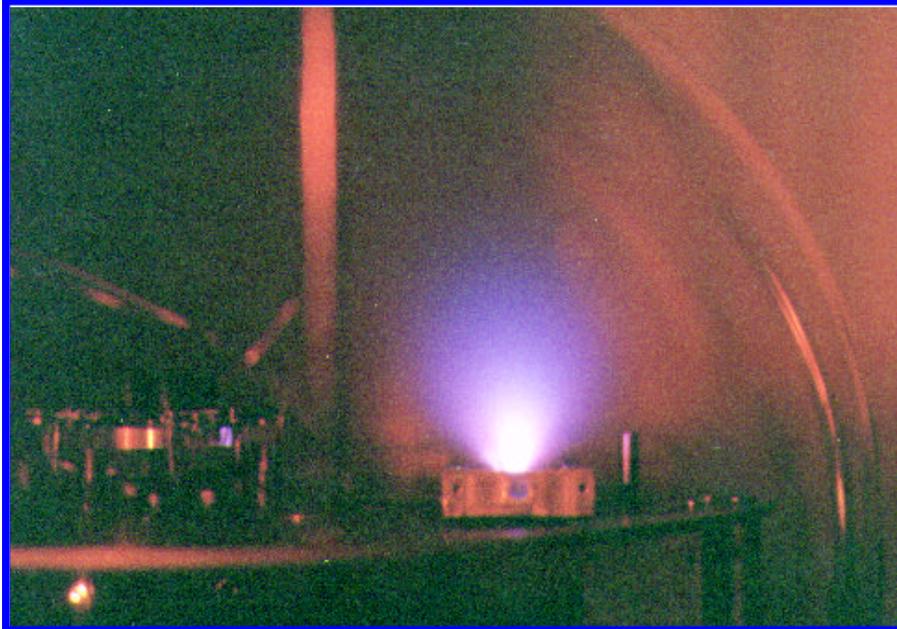


Fig. 11 Front View of Plasma Flash Caused by Sequential Arrival of 2 EVOs Having a Diameter of 10 Micrometers.

One 10 micrometer diameter EVO strike on a stainless steel anode causes only an imperceptible plasma flash that would not be recorded by the method used here. When the first EVO arrival causes a small plasma to be formed that is then struck by another EVO arriving about 1 picosecond later, the flash is many times larger as shown in this self-illuminated photo taken along the path the EVO is traveling. The volume of the flash is over 1 cubic centimeter from this single pair of EVOs used in a particular way. Not many combinations of use produce the same effect.



Fig. 12 Side View of Plasma Flash Caused by Sequential Arrival of 2 EVOs Having a Diameter of 10 Micrometers.

This side view photo is taken of the image shown in Fig. 11. It is the same each time and is not a function of apertures or other plasma limiting devices but rather caused by a fundamental interaction between the plasma produced by the first EVO arrival and the second EVO. The light output difference between this complex interaction and a simple EVO strike on metal is in the order of 1,000 times greater due to a close approximation to something like an impedance match between the second EVO and the plasma.

It should be borne in mind that it is undesirable for an EMP application to put much energy into the visible spectrum when a lower portion of the spectrum is beneficial for electronic device and ordinance destruction.

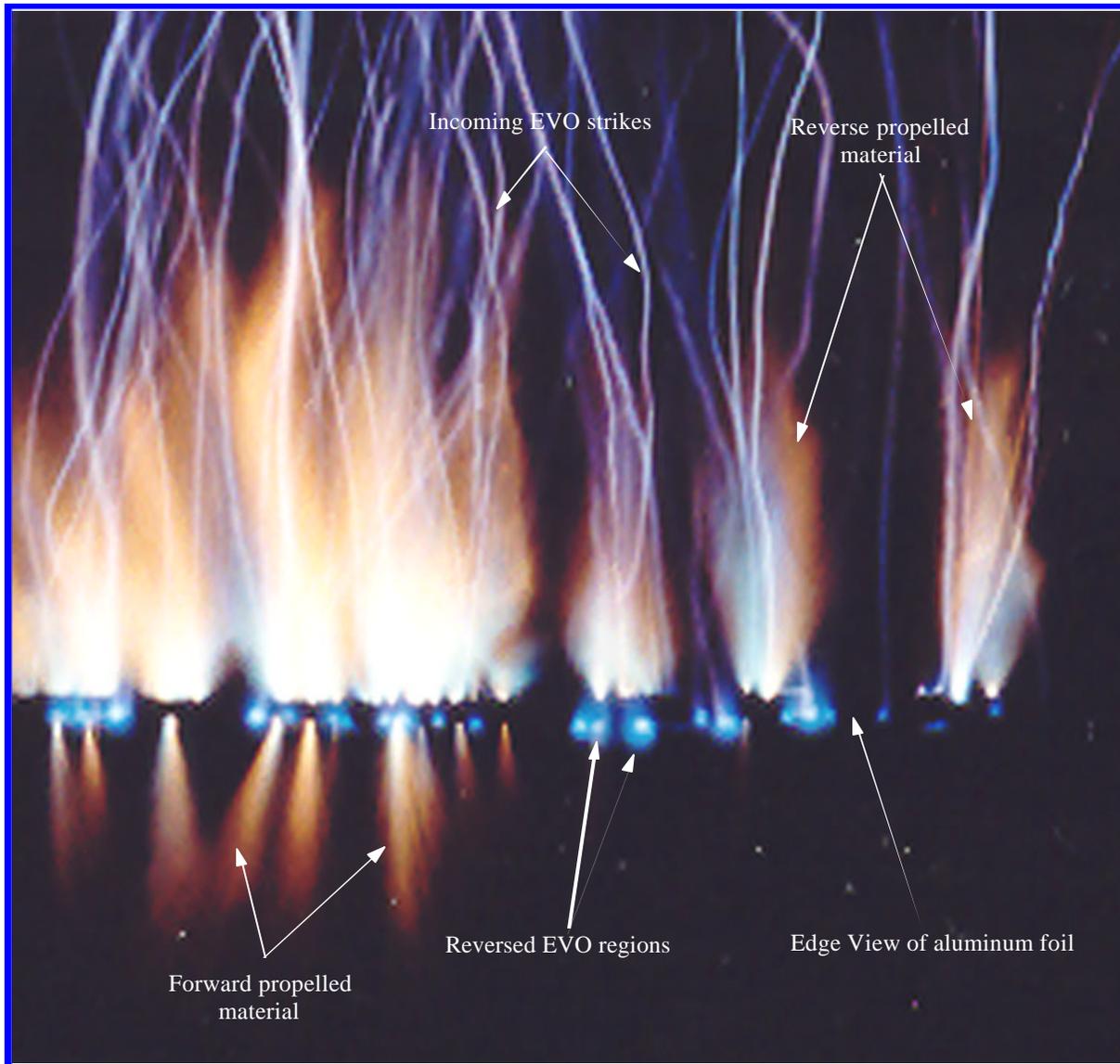


Fig. 13 Edge View of Multiple EVO Strikes in Air on an Aluminum Foil Coated With SiC and Epoxy Mix.

The multiple EVO strikes are caused by an induction coil driven electrode being scanned along the top side of the foil with a spacing of about $\frac{3}{4}$ inch. In some regions the EVO penetrates the 0.02 inch thick coating and 0.001 inch thick foil carrying the fluid out the back side showing as a flare in the photo. In other cases, the EVO just penetrates the coating and foil and then reverses direction carrying the fluidized SiC out the entry direction with high velocity.

The ability to penetrate is tied to having an electrical impedance match for the EVO upon emergence into the space beyond the foil. Deep penetration of materials depends upon having a form of impedance match between the EVO and the material being bored. The EVO matches the impedance of earth and concrete structures. It does not match highly conductive metals.

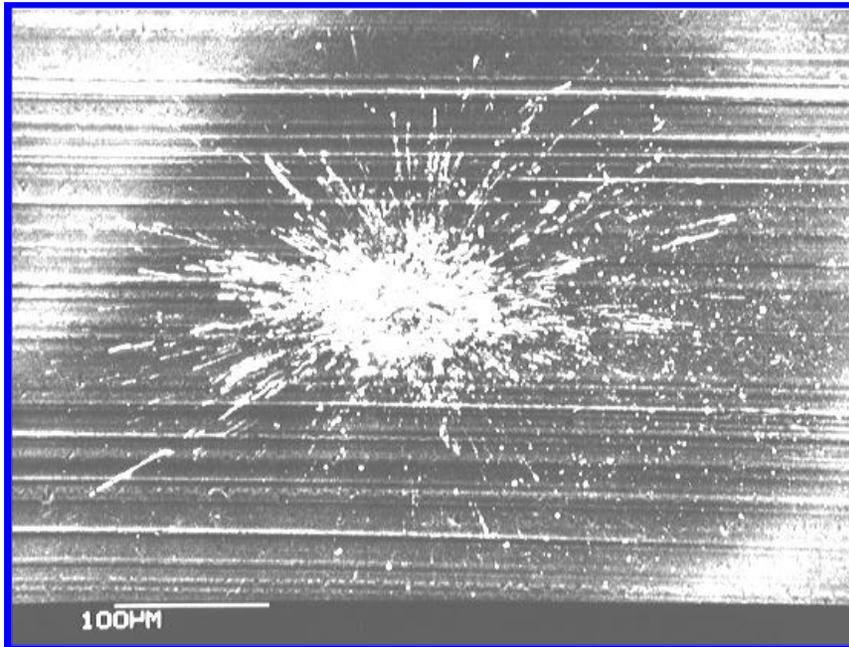


Fig. 14 SEM of High Velocity Deposit of SiC on an Aluminum Target From an EVO Boring Through a Layer of SiC on Aluminum.

When a plate of aluminum is placed below the structure shown in Fig. 13, the fluidized material caused by EVO passage can be driven deeply into the plate. In this instance, the splatter is controlled by the process to spread only laterally and does not strike the foil above it. The fluid slug size is typically 20 micrometers in diameter and 100 micrometers long and has a penetration depth of about 100 micrometers.

If such a slug of material were to strike the enclosure of an electronic device, the internal damage from both particles and radiation caused by the entrained EVO would be severe.

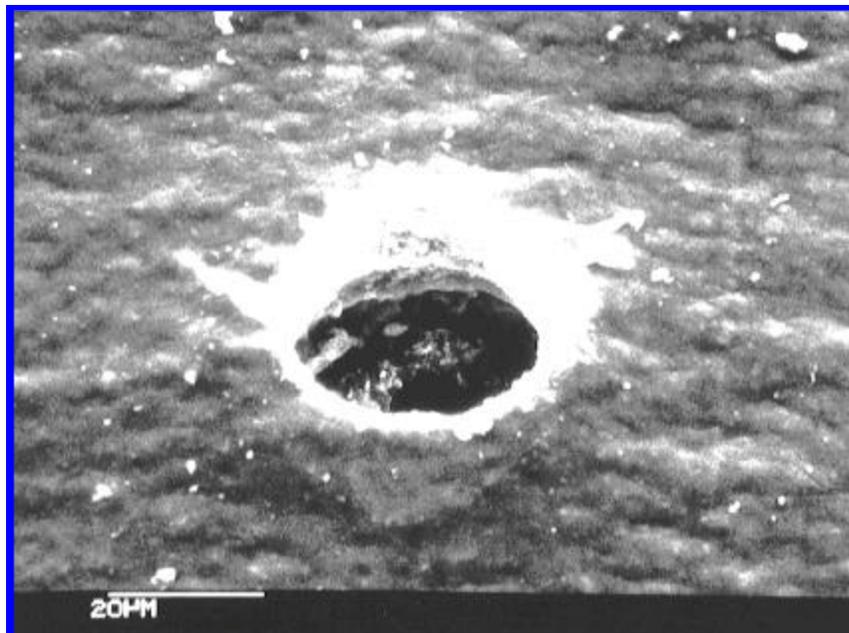


Fig. 15 SEM of Back Side of an EVO Borehole.

The EVO entry side of an aluminum foil showing in this photo is coated with a layer of silicon carbide and epoxy cement. The EVO is generated as shown in Fig. 13. Although there are a variety of borehole exit strategies used by EVOs, most of them are clean holes like this.

It is anticipated that larger quantities of fluidized electrons, properly configured, could bore clean holes into the earth and into ensconced bunker cavities releasing enormous energy into the bunkers encountered.



Fig. 16 Pinhole Camera Image of X-Rays Reaching Inside of Camera by Penetrating Thick Walls.

On the left and right side of the image is a pair of dark vertical lines due to energy absorption of X-rays by these energy analysis electrodes. Normally the field of view is clear of this effect because the camera is designed to image objects beyond 5 mm from the nose, but due to the source of energy being caused by a closer EVO strike on the camera itself, the deflectors show. The white image in the center is the normal electron image from an EVO coming straight at the camera. This image signifies that an EVO landed on the 0.04 inch thick camera nose producing an intense effect yielding x-rays detected by the micro channel plate electron multiplier in the camera. The overall measurement records a high energy EVO strike capable of destroying a large number of shielded semiconductor devices.



Fig. 17 Pinhole Camera Image of Particles Ejected From Rear of Aluminum Foil.

When an EVO strikes the front of an aluminum foil without a hole in it, there is an emission of chunks of material from the backside that can be detected using a micro channel plate electron multiplier operated at a gain of about 10. The speckle image shown is for a mild EVO attack. When allowed to maximize for a 10 micrometer EVO strike by adjusting landing bias voltage, the 0.001 inch thick foil is punctured and a spray of metal particles strike the multiplier causing damage.

The likelihood of severe damage to semiconductors is high when this process occurs even at a low level of activity as it is usually accompanied by x-ray generation when thicker targets are used.

Fig. 18 Text Copied From “EV-A Tale of Discovery” by Ken Shoulders, © 1987

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“The apparatus that first showed the effect is shown in Fig. 6:1 and is the apparatus in which most of the streamer work was done. When streamers rise up from the center electrode and strike the top, they turn and run radially on the flat surface of the cover glass. The run is not entirely straight as they approach the cylinder wall, but at times there is a fair approximation to a radial line. When this happens, the line is viewed from the end in the plane of the top, a bright scintillation can be seen. If a piece of white paper is placed around the cylinder, many scintillations and streaks can be seen.

In order to make the effect more obvious, I caused streamers to run in long glass tubes by exciting them with short bursts of RF at a frequency of between 1.7 and 5 MHz. About 10 cycles of RF was the minimum that I could conveniently generate. Under the conditions that produced small, thin streamers, these streamers would run for a distance of 2 inches or so on the inside of the 3 mm glass tube without turning. Then they would suddenly deflect a small angle and then run straight again. By looking at the deflection point it could be seen that the deflection was caused by something on the surface. I put small grains of various substances on the surface to see what the effect preferred; silica sand was the winner. The sand had bright faces or facets, and I reasoned that it was this optical surface that caused the turn. I also applied the sand to the center electrode and found that it would cause the launching of a streamer whenever the conditions of angle and field were correct. There was no way to control the process with the apparatus used and the effect was strictly a statistical one.

Someday we will get a control on the effect and it may prove to be a laser-like process generating the beam that the EV then rides upon. If such guidance does become practical, there is a good chance for focusing enormous energy density from multiple sources that are a lot easier to make than conventional lasers.”