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Ion Pumping of Cesium and Rubidium

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Cesium and Rubidium are respectively the most electropositive of the alkali metals (of all elements), in purer state both metals will ignite spontaneously in air. Cesium reacts explosively in water while Rubidium reacts violently burning liberated hydrogen from the water reaction.

Cesium & Rubidium are very high vapor pressure metals capable of migrating quickly to all areas of a vacuum system particularly when the source of the metals is heated. When ion pumps are exposed to quantities of migrating Cesium or Rubidium great enough to form a coating over the ceramic insulators an electrical leakage path develops between the anode and cathode of the ion pump element. Ion pumps will draw increased current from their high voltage power supplies if the ceramics become coated, this increase in current will cause ion pump pressure to appear higher than it actually is.

Electrical leakage in an ion pump can be measured by removing the ion pump magnets and powering the ion pump this is usually much easier to do on small ion pumps. Without magnets attached an ion pump will not pump so all current that is measured is leakage, some or all of which may come from Cesium or Rubidium coating the ceramics.

To improve the condition of an ion pump that has electrical leakage due to Cesium or Rubidium it may be rinsed in de-ionized water. Cesium and Rubidium form oxides as an ion pump is vented, these oxides are very soluble in water. A rinsing process is more successful in newer ion pumps and may cause the ion pump to short circuit if other metallic compounds formed during ion pumping are washed across and remain on the ceramic insulators. A rinsed pump will have to be thoroughly free of all water before reinstallation.

Oxides of Cesium (CsO) and Rubidium (RbO) are very stable compounds much less conductive than the raw metals. Venting an ion pump to oxygen or air will stop the electrical leakage in an ion pump by forming oxides with the alkali metals, oxygen is the better choice if UHV is needed without baking. Oxides of Cesium and Rubidium will re-refine themselves into their raw metals if the ion pump is baked under vacuum causing electrical leakage to return. **Cesium and Rubidium react violently in the presence of Oxygen or air, these gases should not be introduced into a vacuum system unless you are sure the amount of alkali metals will create only an insignificant reaction!!!**

Baking an ion pump into another pump at temperatures of 150 - 200°C will remove Cesium and Rubidium but this will transfer the alkali metal contamination into more vacuum equipment.

Once an alkali metal has been introduced into a vacuum system it will always have at least a small background of the metals unless every part is completely chemically cleaned.