Catheter Electrodes
There are several different broad categories of electrodes used in catheter assemblies; ring electrodes, electrode pads, probes, cores and wires. Traditionally catheter manufacturers and OEM’s implement platinum-iridium (Pt/Ir) or stainless-steel electrode components, through laser micro-machining, crimping, coiling or swaging onto industry standard nitinol, tungsten, MP35N, or stainless-steel base materials. These electrodes are typically applied to the tips of a catheters, pull ring assemblies, discrete struts of stents, flexible laser-slotted hypo-tubes and rigid hypo-tubes, guidewire tips, needles, mandrel cores and other similar catheter-based components. The most common functional uses of catheter electrodes are broadly categorized as ablation, stimulation, and sensing electrodes. More specifically there are several designs commonly used in electrode applications which are monopolar, concentric, and macro electrode designs.

The Challenge
Electrode materials often must be highly electrically conductive or resistive depending on the application, thermally conductive as well as biocompatible, with a low potential for corrosivity and dissolution. Gold and platinum are often the preferred material for electrodes used in the medical device industry. Pure Platinum & Pure Gold are too soft to be machined as an electrode or a radiopaque marker for a catheter assembly, which is why Pt/Ir and SS are often used even though there are downsides to performance and limitations for installation into a catheter build. Unfortunately, stainless steel electrodes are far less thermally and electrically conductive than precious metal electrodes. Pt/Ir electrodes cannot easily be installed onto complex geometries and reduce component flexibility, they also have design limitations in regards to wall thickness for a ring-electrode because traditional machining of Pt/Ir has constraints due to the subtractive nature of the process, which in turn results in a larger dimensional profile. Platinum-iridium alloys can also be vulnerable to corrosion and dissolution with some intensive stimulation protocols.

The Engineered Solution
Rather than use a machining process and various methods of limited installation for rigid stainless steel or platinum-iridium alloys as markers and electrodes, ProPlate instead uses pure platinum or gold with its additive plating process. In this scenario, electroplating has a clear advantage. Instead of subtractive machining followed by an installation process such as swaging or crimping, electroplating builds the platinum or gold layer gradually, several micro-inches at a time, and can be selectively applied in a myriad of shape and thickness designs with tight control of tolerances. Therefore, it is advantageous in this specific application to use an electrode installation because it allows pure soft forms of metal to be used, opposed to hard platinum iridium alloys. Compared to Pt/Ir alloys and SS, pure gold and platinum are superior at conducting electricity and have other performance advantages. The advantage of Gold or Platinum being that Pure Gold shares similar properties and characteristics with pure Platinum regarding biocompatibility, low potentials for corrosivity and dissolution, high density, ductility and malleability. Gold is a superior electrical and thermal conductor, while platinum has higher electrical resistivity and hardness properties in comparison. These properties are often advantageous for catheter component performance especially for applications requiring electrodes for sensing, stimulation and ablation. ProPlate uses electroplating processes to apply Gold or Platinum onto complex catheter component geometries, often resulting in lower dimensional profiles and eliminating the risk of marker or electrode ring dislodgement. Gold electrodes and pure platinum electrodes may result in a higher ablation success rate and reduce incidents of char/coagulation formation, making these electrodeposited metals the preferred electrode material of choice over platinum-iridium electrode or stainless-steel materials used in ablation applications.