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PRINTED CIRCUIT DESIGN & FAB

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As Good as Gold?

Copper doesn't do a body good, but the price of other metals may leave you breathless.

QUESTION: CAN A flex circuit be made with platinum or gold conductors rather than copper?

Answer: This question has come up 50 times or more at the several medical device trade shows we attend each year. My first response is always to ask if they need solid gold/platinum conductors, or simply copper conductors plated with these precious metals. The usual response from the inquirer is that the need is for solid gold or platinum, specifically no copper content *whatsoever.* The application is always implantable or at least human body invasive. I don't claim to be an expert on FDA regulations, but there is an obvious dislike for copper invading the human body.

In previous years, I would reply that there was no known way to do this. Since flexible circuits are produced using a photo-etch process, the manufacturer must use a foil that the chemical etchants will attack. The most commonly used etchants by flexible circuit manufacturers are cupric chloride, ferric chloride, and to a lesser extent some ammoniacal etchants. The problem is that gold and platinum are not affected by any of these etchants, so you cannot use the photo-etch process to create a gold/platinum conductor flex circuit. This greatly limits the manufacturer's options for forming the metal features on the flexible circuit. Since chemically ablating the unwanted precious metal surrounding the conductors is not an option, the only other alternatives (staying with a subtractive process) would be either laser ablating or mechanical milling. Neither of these options is viable due to the very thin nature of the materials being removed, and also by the very thin dielectric base material that must be left behind to keep the conductors in place after processing. All of the above assumes a sheet metal mill could be found that would be willing to make a roll of gold or platinum foil in the first place. If you do find a taker, better have very deep pockets. It would be very difficult to roll gold or platinum foil to less than 0.0005". At that thickness and the current market price for gold, the cost for the gold *alone* would be over $500 per sq. ft. The rolling mill would then tack on its margins, which I am sure would push up the cost an additional several hundred dollars per square foot. With the cost of raw materials for the circuit hovering just under $1,000 per sq. ft., imagine what the cost of the finished circuits would be.

The other method of producing a flex circuit would be an additive process as used in printed electronics (membrane circuits). In this process, conductive paths and insulating layers are added to the base substrate one layer at a time. Most conductive inks used in membrane circuits utilize silver particles suspended in a liquid carrier. The liquid carrier could be room-temperature curing ink solutions, or a two-part agent, like epoxy. Many types of metal particles could be used to make the ink conductive, including gold and platinum. Problem solved, right? Not so fast. Several conductive ink companies have indicated that they can produce this type of mix, but the cost would be up to $10,000 *per ounce*. Yikes! Considering that the membrane manufacturer would need about an ounce of ink just to flood the screen prior to printing any circuits, this would be an outrageously priced product. There is a good chance that a printed gold or platinum circuit could actually cost more than just using gold or platinum foil.

The last method for producing this type of circuit would be to have the gold or platinum vapor deposited (sputtered) onto a flexible base dielectric film. This technology falls well outside of my area of expertise, so I cannot speak to the pricing or feasibility of doing this on a large scale. I do know that the process is feasible and that metals have been successfully sputtered onto flex substrates in the past. But you will have to do your homework to determine if this process will support the application that you have.

There are ways that this type of circuit could be manufactured, but using the current processes available to PCB manufacturers, the cost is prohibitive, to say the least. Vapor deposition (sputtering) may hold more promise, but that process also has its limitations. To answer the question, you could probably get what you are looking for, but at least for now there will be a fairly hefty price tag attached. PCD&F

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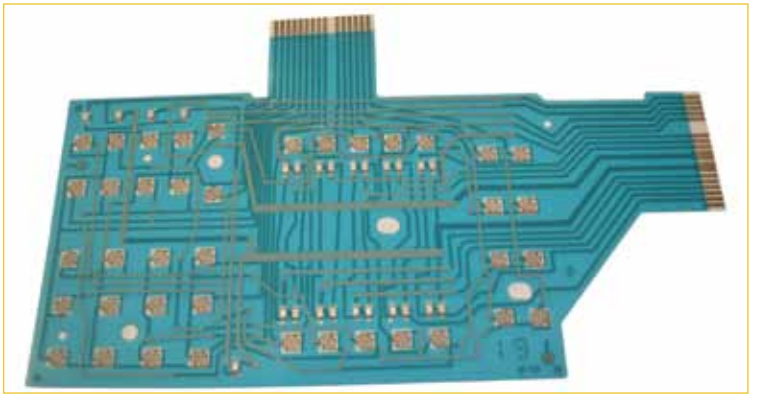

FIGURE 1. Flexible circuits with printed conductive ink (usually silver-based) have been manufactured for years. Using the same process with a gold- or platinum-based conductive ink is feasible but cost-prohibitive.