substrate can itself be considered a layer of radiation reactive material.

While it is preferred that a self-assembling monomolecular film be chemically absorbed on the surface of a substrate having functional groups, in some cases, the film can be formed or considered a part of the outer surface of the substrate. Thus, if a substrate has a chromophore embodied in it, that is a material which absorbs the wavelength to which it is exposed and changes its receptivity to electroless plating from receptive to metal plating to not receptive to metal plating or vice versa, that substrate can be used directly without an additional monomolecular film being formed thereover. In all cases, the outer layer of the substrate (which can be considered a monomolecular film portion thereof) or monomolecular film applied thereto has a surface which is either receptive to metal plating by electroless techniques or not. Radiation is then used to change the surface to not receptive if it was previously receptive or vice versa, after which a catalyst is used to enhance plating which is then carried out by electroless plating techniques to deposit or not deposit metal in defined areas. When a mask or pattern application is used with irradiation prior to the deposition of the metal, the metal is applied only to a predetermined area and the metal itself can be a mask for later steps. That is the metal layer can be a resist against etching or in the case of printed circuit boards, masks and microwave circuits the metal layer can be the final product. This enables one to fabricate products where the built up metal layer is built up where desired for ultimate use and no metal need be removed.

While specific monolayer films have been described and include specific silanes, other films can be applied to surfaces and can include many different silanes including perflourinated silanes such as tridecafluoro-1,1,2,2-tetrahydrooctyl) -1-dimethylchlorosilane, octadecyldimethylchlorosilane, trifunctional silanes such as trichlorooctenylsilane, trimethoxyoctenylsilane, trimethoxy-4-aminobutylsilane

Other materials which are radiation reactive, act as chromophores and which attach to the substrates can be used and include titanates having the general formula $Ti(OR)_4$ where all four of the OR organic groups may be the same or different. These materials and related zirconate and aluminate classes of molecules are recognized to be similar to silanes in that they spontaneously react with surface hydroxyl groups to give an organic monolayer covalently linked to the substrate with the evolution of an alcohol. An O-Ti bond is formed between the surface hydroxyls and the titanates. Titanates such as 2-propanolato-tris (phosphato-O-dioctyl)titanium(IV), UTF12; methoxydiglycolylato-tris-O-(2-propenoato) -titanium(IV), (UTF39); 2-propanolato-tris (3,6-diazahexanolato)titanium(IV), (UTF44) can be used to achieve a selective metal pattern. Other film forming materials for the monolayer can be used which include Langmuir Blodgett films, thiol or disulfide films that assemble on gold surfaces, carboxyls or acid chlorides.

Film thickness of the metal layers deposited can be as known in the electroless plating art for electrical purposes and can be for example 20 nm thick in continuous films with resolution as desired as for example in the 0.5 micron metal width to 0.5 micron spacing width range or lower as for example 0.2 micron metal width to 0.2 micron spacing between metal lines when high energy short wavelength radiation such as 200 nm radiation is used.

In addition to the substrates described above, substrates that can be directly patterned without the use of an additional monomolecular film but which have an outer film carrying a chromophore can be used These substrates can be organic or inorganic materials that have a top surface with a chromophore in the wavelength of interest. Such substrate materials include the following wherein the image to be of metal deposited after irradiation can be negative or positive, that is, a positive image has catalyst adhesion and subsequent metal deposition only in the unirradiated areas of the substrate, whereas a negative image has catalyst adhesion and subsequent metal deposition only in the irradiated areas:

Polyethylene - negative
Paraffin negative
Polypropylene - positive
Polyethylene terephthalate (Mylar) - positive
Polyether polyurethane - positive
Polyisoprene (natural rubber) - positive
Polysulfone - positive
Polymethylmethacrylate (Plexiglas) - positive
Polyacrylic acid - positive
Poly(cis-1,4-butadiene) - negative
Polyurethane - positive
RTV Silicone rubber - positive
Polyethersulfone - positive

Obvious modifications that do not depart from the essentials of the invention are apparent to those skilled in semiconductor fabrication or in printed circuitry or in the chemistry of thin films. In view of the changes in the invention that are obvious to such skilled persons, it is intended that the invention not be limited to the precise procedures here described and not to the specific materials used in those procedures. Rather, it is intended that the scope of the invention be construed in accordance with the accompanying claims, having due consideration for changes that merely involve obvious equivalents and for the substitution of materials having known similar properties.

We claim:

1. A process for producing conductive paths on a substrate of the kind having polar functional groups at its surface, comprising the steps of;

(a) causing a self-assembling monomolecular film to be chemically adsorbed on the surface of the substrate,

(b) altering the reactivity in regions of the film to produce a predetermined pattern in the film,

(c) causing a catalytic precursor to adhere only to those regions of the film that have sufficient reactivity to bind the catalytic precursor, and

(d) placing the substrate in an electroless metal plating bath whereby a metal plate is produced in those regions having the catalytic precursor thereon.

2. The process according to claim **1** wherein the substrate is a semiconductor substance and wherein the self-assembling monomolecular film is a silane of the R_nSiX_m type where;

R is an organic functional group;

n=1,2 or 3;

m=4-n; and

X is selected from the class consisting of a halogen, alkoxy or amine.

3. The process according to claim **1**, wherein the substrate is a solid of semiconductive silicon and