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Activation of amino-based monolayers for electroless metallization of high-aspect-ratio through-silicon vias by using a simple ultrasonic-assisted plating solution

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Abstract

In this paper, we present the method and results of electroless plating of through-silicon via (TSV) contacts using Ni nanoparticle seeds on self-assembled monolayers (SAMs). This approach where the nanoparticles are evenly distributed and stabilized on the SAM allows the successive electroless metallization schemes such as Co-alloy barrier and Cu plug used typically in TSV as interconnects. The seeding was tested on SiO₂ layers with surfaces functionalized by an amino-based aminopropyltrimethoxysilane (APTMS) SAM. APTMS-SAM after a suitable SC-1 treatment yielded a remarkably good barrier layer, with high adhesion strength (70 MPa) and low electrical resistivity (28 μΩ-cm). Moreover, the SAM assisted seeding protocol was followed by an ultrasonic-assisted (or mechanically agitated) electroless-plating stage together with a relatively simple plating solution.

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