UCI Samueli School of Engineering

Department of Materials Science and Engineering UCI

UNIVERSITY OF CALIFORNIA, IRVINE

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

IS PROUD TO HOST A SEMINAR BY

"FABRICATION AND APPLICATIONS OF NANOTWINNED CU FOR HYBRID BONDING IN SEMICONDUCTOR ADVANCED PACKAGING"

CHIH CHEN

PROFESSOR & CHAIR
DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING
NATIONAL YANG MING CHIAO TUNG UNIVERSITY (NYCU), TAIWAN

Thursday, January 9, 2024

2:00 PM - 3:20 PM

McDonnell Douglas Engineering Auditorium

Abstract: Cu is the most important electrical conductor material in semiconductor devices. This talk will introduce the direct current electrodeposition of highly (111)-oriented nanotwinned Cu (NT-Cu) and its unique properties, including high surface diffusion rate, high mechanical strength, anisotropic grain growth, and low oxidation rate. The NT-Cu has been adopted as interconnects in advanced packaging of 3D integrated circuit (IC) to provide high bandwidth and low power consumption. In this presentation, low temperature CuSiO2 hybrid bonding, and high electromigration lifetime redistribution lines using the NT-Cu will be presented. The bonding temperature can be lowered from 300 □C to 150□C-200 □C, and the pressure is as low as 1.06 MPa. The bonding process can be accomplished by a 12-inch wafer-to-wafer or die-to-die scheme. The measured specific contact resistance is 1.2 □ 10−9 Ω·cm2, which is the lowest value reported in literature for Cu-Cu joints bonded below 300 □C. In addition, the electromigration lifetime of the NT-Cu lines is four time longer than that of the regular Cu lines.

Bio: Professor Chih Chen received his Ph.D. degree in Materials Science of UCLA in 1999. He joined National Yang Ming Chiao Tung University (NYCU), Taiwan as a professor in 2000. He served as the Chairman of Department of Materials Science and Engineering in NYCU from 2017 to 2023. Professor Chen discovered electrodeposition of (111)-oriented nanotwinned Cu, and reported it in Science (2012) and transferred the fabrication technology to Chemleader, Taiwan for mass production in 2016 in semiconductor advanced packaging. He received the 2016 National Innovation Award and TMS 2018 Research to Practice Award. His current research interests are low-temperature Cu-Cu direct bonding, high strength nanotwinned Cu lines and films for 3D IC integration. He wrote a book on Electronic Packaging Science and Technology (Wiley 2021) with Profs. King-Ning Tu and H.M. Chen.