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Single-Crystal-Islands Technique of Si for Monolithic 3D BEOL FinFET Circuits

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Abstract

As Moore's law proceeding, the scaling of transistors reached to its physics limits. The concept of monolithic 3D ICs thereby attained more and more interest and was considered to be a convincing technique. In this study, a single-crystal-islands (SCI) technique was demonstrated using low thermal budget pulse laser process to fabricate single-crystal silicon islands for monolithic 3-D back-end-of-line (BEOL) FinFET circuits. The lithography-defined silicon islands were placed on cooling holes and encapsulated in comformal silicon nitride films. By laser recrystallizing those, the single-crystal Si islands would be obtained. The crystallinity of Si islands was first verified with SECCO Etch, HREM, TEM, and EBSD. Furthermore, the BEOL FinFETs in SCI Si islands were following fabricated to certify their performance. Thanks to the single-crystalline Si islands free from grain boundary degradation, the FinFETs in SCI Si islands exhibited better average on current (I_{ON}) of 311.73 μA/μm and lower intra-device variability than the ones in poly-Si. Therefore, the fabrication of FinFETs in SCI technique would be a promising art for monolithic 3D BEOL FinFET circuits.