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An Investigation of Laser Annealed and Metal-Induced Crystallized Polycrystalline Silicon Thin Film

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Today semiconductor electronics is used in many fields. For example, thin-film polycrystalline semiconductor materials are promising for micro-, nano-, optoelectronics [1] and photovoltaics [2]. One of the key needs for industrial production is the cheapening of such materials, in particular, the use of glass and plastic as substrates. The main method for producing thin films of polycrystalline silicon is thermal annealing of amorphous silicon films. However, thermal annealing is demanding to external conditions: high temperature of the process (more than 600 °C), the need to maintain a high vacuum, duration (more than 10 hours). There are alternative methods of crystallization, for example: laser-induced crystallization (LIC)[3] and metal-induced crystallization (MIC)[4]. It was aimed to combine MIC and LIC to obtain a fast and undemanding crystallization method.

This paper presents the results of an experimental study of amorphous silicon crystallization using nanosecond pulsed laser annealing in combination with the metal induced crystallization method. The sample is a layered structure of a 30 nm thick gold film and a 130 nm thick amorphous silicon film. Two wavelengths, 532 and 1064 nm, were used for laser annealing. The modification thresholds for the wavelengths used were determined. IR radiation modifies the material and has a large operating energy range. When exposed to visible radiation, tearing and delamination of the composite film was observed. Similar experiments were carried out in vacuum. RAMAN spectroscopy of the material showed that silicon crystallizes under the influence of IR radiation. The morphology of the film after laser treatment was studied by electron scanning microscopy

For the first time gold was chosen as a donor metal for such a process, since it forms with silicon the eutectic point with the lowest temperature and does not oxidize. The possibility to crystallize amorphous silicon by the proposed method, both in air and in vacuum, was shown. In the future, other possible modes of op-

eration will be searched for and the dependence of the process on the laser pulse duration will be investigated.

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