cessing conditions of P1 scribing of thin film solar cells with an SnO 2:F back contact layer. The approach can be readily applied to other types of solar cells, and even be used to determine the opti-mumprocessing window for other scribing types such as P2 and P3 scribes. Acknowledgment This work is supported by GOALI grant CMMI-1333241 from NSF.

In this study, we explore optimal laser scribing conditions for copper-indium-gallium-selenide (CIGS) thin-film solar cells, especially based on flexible ...

Finding ways to scribe indium-tin oxide (ITO) coating plays an important role in the fabrication and assembly of thin film solar cells. Using a femtosecond (fs) laser, we selectively removed the ITO thin films with thickness 120-160 nm on glass substrates  particular, we studied the effect of laser pulse duration, laser fluence and laser scanning ...

We present our results on scribing of CIGS thin-film solar cells with single and multiple parallel laser beams with the picosecond pulse duration. Solar-cell performance tests ...

This paper aims to review the progress made in the past decades in laser scribing of all kinds of thin film solar cells. In this work, we focus on the studies of non-silicon ...

Laser Surface Texturing, Crystallization and Scribing of Thin Films in Solar Cell Applications Hongliang Wang Thin films have been considered for use in terrestrial solar cell applications because of their significantly reduced cost compared with bulk crystalline silicon. However, their overall efficiency and stability are less than that of their bulk crystalline counterpart.

The development of thin-film photovoltaics has emerged as a promising solution to the global energy crisis within the field of solar cell technology.

Photovoltaic cells offer a clean and sustainable solution by allowing the reduction of fossil energy. In recent decades, several types of solar cells have been proposed to overcome the limitation of stiffness of common silicon-based solar cells. Due to their flexibility, thin-film solar cell technology is now of great interest to the community. Now, most of the thin-film solar cell ...

The photovoltaic (PV) system has the best chance of harnessing solar energy to generate affordable electricity (Rodrigues et al., 2022).Thin-film solar cells are preferred in PV devices owing to their low cost, low material consumption, and a positive trend in efficiency growth (Efaz et al., 2021, Liu et al., 2020) pper indium gallium selenide (Cu(In,Ga)Se 2, known as ...

Building-integrated photovoltaic (BIPV), especially in a semitransparent and/or see-through configuration, has attracted significant attention because of the extended surfaces available for the photovoltaic (PV) installation

including roofs, facades, and windows. In this study, we examine the P4 scribing process for fabricating see-through cells on a new Cu (In,Ga)Se2 ...

Modeling, laser scribing, multilayer thin films, SnO2:F, CdTe, solar cell INTRODUCTION Thin-film solar cell is a promising technology to achieve a significant cost reduction in materials, large area deposition capability, and the use of cheap and flexible substrates. Cadmium telluride (CdTe) is the dominant thin film solar cell material in ...

In this study, we examine the P4 scribing process for fabricating see-through cells on a new Cu (In,Ga)Se 2 (CIGS) architecture with indium tin oxide (ITO) bottom contact, using a nanosecond laser beam of 532-nm wavelength illuminated from glass substrate side. Through parametric studies with the variations of laser beam spot size and pulse ...

In this study, a ns Nd:YAG laser operating at the fundamental (1064nm) or frequency-doubled (532nm) wavelengths is employed for pattern 1 (P1) and 2 (P2) scribing on CdTe thin-film solar cells. The experimental investigation shows that film removal mechanisms for different materials are due to laser-induced ablation, thermal stress and micro ...

of solar cells. The production cost is greatly reduced in thin-film based solar cells fabrication, as compared to wafer-based solar cells.[1] The energy conversion efficiency of the solar cell is significantly affected by the machining precision of slot geometry, i.e., the edge and the bottom. For thin-film solar cells, laser scribing has been

Researchers have proposed induced ablation as an alternative laser scribing technique to achieve highly selective film removal and steep wall scribes. Employing this approach for scribing CZTSe thin-film solar cells with an IR ps laser has improved removal quality, selectivity, and crater edge quality without the presence of defects .

Thin-film solar cells (TFSCs) still hold unlocked potential for achieving both high efficiency and low manufacturing ... solar cells near the laser-scribing zone, together with efficiency and ...

of thin film solar cells are conducted using Bessel beam nanosecond laser pulse. The purpose is to assess the capability of the Bessel beam in laser scribing of thin film solar cells from the glass side. In order to fulfill this purpose, a Gaussian beam of 1064 nm nanosecond Nd:YAG was shaped into Bessel beam with

Cu(In,Ga)Se2 (CIGS) thin films, a promising photovoltaic architecture, have mainly relied on Molybdenum for the bottom contact. However, the opaque nature of Molybdenum (Mo) poses limitations in module level fabrication by laser scribing as a preferred method for interconnect. We examined the P1, P2, and P3 laser scribing processes on CIGS photovoltaic ...

The selective laser structuring of zinc oxide thin films, which serve as the transparent negative electrodes of

copper-indium-selenide (CIS) thin film solar cells, is of great common interest as ...

Using a picosecond laser, preliminary results on the scribing of CuInGaSe2 thin film solar cells deposited by the low temperature pulsed electron technique, are reported. The complete ...

The upscaling of perovskite solar cells is one of the challenges that must be addressed to pave the way toward the commercial development of this technology. As for other thin-film photovoltaic technologies, upscaling requires the fabrication of modules composed of series-connected cells. In this work we demonstrate for the first time the interconnection of ...

Femtosecond laser scribing is an effective tool for CIGS solar cells with keeping high efficiency. Keywords: CIGS solar cell, femtosecond laser scribing, shunt resistance, photovoltaic efficiency, EBIC . 1. Introduction . The chalcopyrite Cu(In,Ga)Se. 2 (CIGS) is one of the most promising thin-film solar cells because it has high

This comprehensive review of laser scribing of photovoltaic solar thin films pivots on scribe quality and analyzes the critical factors and challenges affecting the efficiency and...

Cd 2 SnO 4-based CdTe solar cell is a potential technology to fabricate low cost and highly efficient thin film photovoltaic modules due to the excellent optical and electrical properties of Cd 2 SnO 4 conductive transparent layer. However, the detailed research on patterning process is still deficient. In the present work, we developed laser scribing ...

The picosecond pulsed laser scribing of flexible CdTe thin-film solar cells with CTO film as the front electrode was studied. Direction ablation was performed using lasers with the wavelengths of 355 and 532 nm. It was found that the damage and removal thresholds were influenced by the LSS, upper layers, and laser polarization state.

use laser scribing method for fabricating high-quality flexible thin-film solar cells. Despite the fundamental merits that laser scribing can offer, still a number of challenges should be addressed in order to replace the mechanical counterpart for wider range of thin-film solar cells. In this study, we explore optimal laser scribing

Process and laser optimization are key for high throughput and precise clean scribes. Arecent article presented an overview of how lasers can play a key role in the development and production of solar devices, delivering twin benefits of lower fabrication costs and superior performance (see ILS, August 2007, p. 24).Laser scribing is rapidly emerging as ...

in scribing the CIGS thin-film solar cells deposited on flexible polymer substrate. Evaluation of laser scribe quality, elemental analysis, investigations of local electrical properties of solar cells near the laser scribing zone together with efficiency and parallel resistance measurements are presented for both pulse durations.

The solution is to cut the film into smaller cells and provide series interconnections. This way, the same 1-m 2

film with 100 integrated cells would produce only 1.25 A at 80 V but yield the same power as the larger cell. The challenge is to achieve the interconnections with the smallest possible loss of thin-film real estate.

The thin-film technology is the most promising technology to achieve a significant cost reduction in solar electricity. Laser scribing is an important step to preserve high efficiency of photovoltaic devices on large areas.

The effect of laser-induced heat on Cu(In,Ga)Se2 solar cells was evaluated by scanning spreading resistance microscopy (SSRM) to improve the laser scribing (LS) quality.

Over the last few years, thin-film based CIGS solar cell technology became even more attractive for producers and end-users. Implementation of laser based tools for module scribing still face serious challenges in terms of the laser damage to the CIGS active layer.

The efficiency of the thin-film solar cells with a large active area might be maintained making series interconnects in order to reduce photocurrent in thin films and resistance losses. Laser

As the third generation of photovoltaic cell technology, the Perovskite Solar Cells (PSCs) have strong theoretical advantages compared with discrystalline silicon and thin film cells because of their material characteristics. In the formation of the series structure of perovskite cells, different film layers need to be marked at different positions. The scribing of ...

Laser scribing is a highly beneficial tool in the fabrication of thin-film solar cells, which typically consist of multiple layers of materials deposited on a substrate. However,