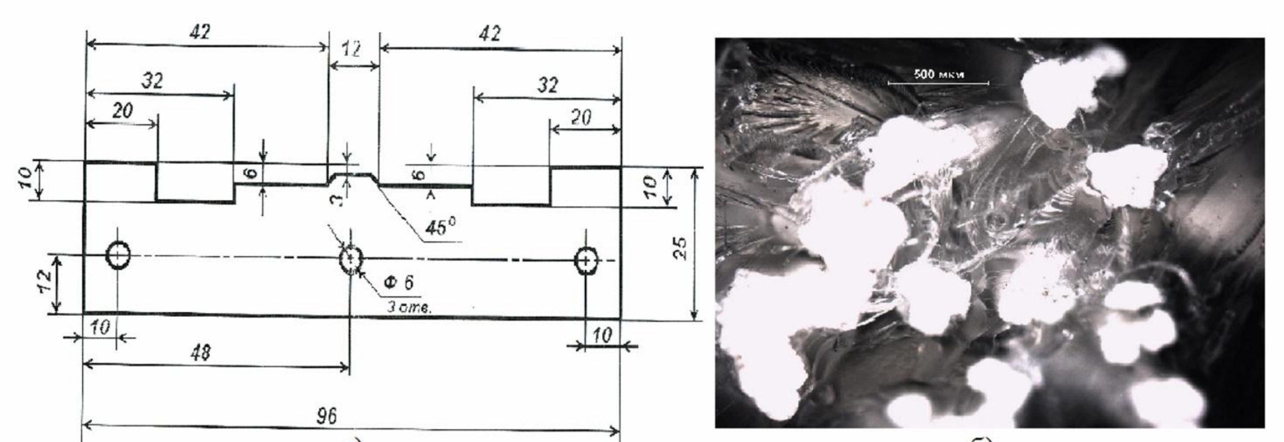
$$\sigma_{\text{КМ}} = \sigma_{\text{вол}} \cdot S_{\text{вол}} + \sigma_{\text{м}} \cdot (1 - S_{\text{вол}}) \tag{1}$$

где $\sigma_{\text{км}}$, $\sigma_{\text{вол}}$, $\sigma_{\text{м}}$ – предел прочности композиционного материала, волокна, матрицы соответственно (МПа); $S_{\text{вол}}$– относительное сечение волокон(отн. ед.).

Так, согласно вышеописанной методике, предел прочности керамических волокон, синтезированных посредством пропитки вискозной нити раствором нитрата цирконила с добавкой нитрата иттрия с суммарной концентрацией металлов 500 г/дм^3(в пересчете на оксиды) с добавлением 10 мас.% поливинилового спирта (10% водный раствор), составил 212,8 МПа.



а) б)

Рис. 1. а) – Заготовка для изготовления ячейки для отливки образцов; б) – Фрактограмма излома шейки образца с керамическим волокном

COLLOIDAL QUANTUM DOTS DOWN-CONVERTERS FOR SILICON SOLAR CELLS

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The combination of solar cells (SC) with luminescent “down converters” based on colloidal quantum dots (CQD) have been suggested as a very promising method to high power conversion efficiencies. For “down-conversion”, the luminescent converter (LC) as a thin film containing CQD is located on the front surface of the SC. High-energy photons with energy more than Eg are absorbed by the converter and down-converted into lower energy photons which, in turn, can be absorbed by the solar cell. In this work we investigated the use of CQD (PbS, PbS-/CdS, CdSe/ZnS, CdTe) in photovoltaic technology to increase the efficiency of silicon SC.

As a result of the mismatch between the incident solar spectrum and the spectral absorption properties of the material, conventional silicon SC effectively convert photons only with energy close to the Si band gap. This loss can be reduced by using photoluminescence, where photons are shifted into the energy range where the cell has a higher spectral response. CQD were proposed for application as down-shifters because the emission wavelength can be tuned by their size as a result of quantum confinement. In order to analyze the effect of the LC we performed a series of optical and PV measurements. The LC or thin layers were characterized using PL measurements to verify the CQD formation and quantify their light emission. There is a high PL emission with a peak at 627 nm (CdSe/ZnS), 761 nm and 820 nm(CdTe), 875 nm (PbS/CdSe), respectively. Figure 1 shows the diffuse reflectance spectra of SC (1), coated with one ($1^{/}$) orthree ($1^{//}$) layers, luminescence spectra of CdSe/ZnS (2), CdTe (3) and PbS/CdS (4). Optical measurements of SC without LC and with one and three LC layers were performed in order to determine the fraction of the incident light reflected from the cell, absorbed by the layers, and transmitted into the silicon solar cell. These measurements showed a decrease in the reflected lights to 27%, 17% in UV region after coating.

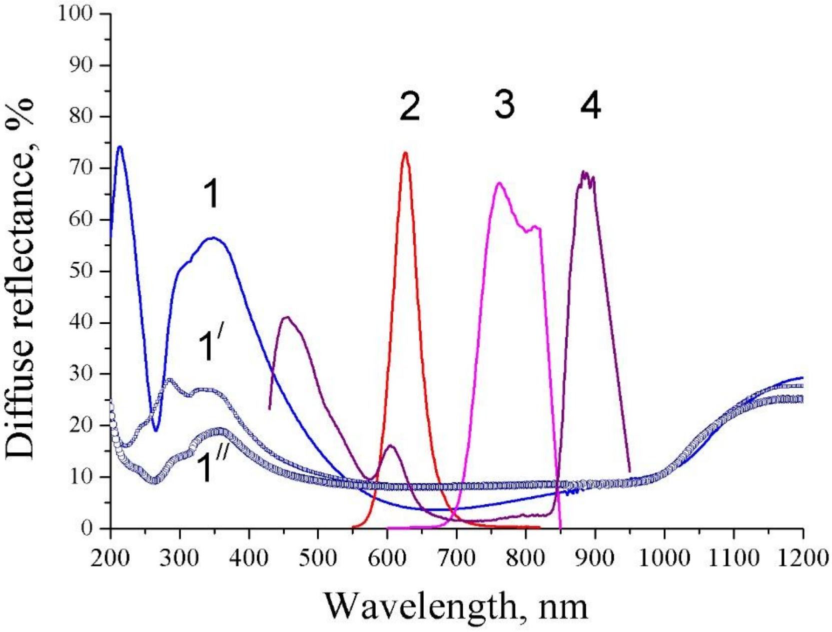

Fig.1. Diffuse reflectance spectra of SC(1), SC coated with one ($1^{/}$) and three ($1^{//}$) LC layers, luminescence spectra of QCD CdSe/ZnS(2), CdTe(3), PbS/CdS(4).

PV measurements were performed at 25 ^{o}C, AM1.5 irradiation to extract the power conversion and quantum efficiency of the solar cells. These measurements showed an increase of efficiency of coated SC to Δ4% (CdSe/ZnS), Δ8% (PbS/CdSe) and Δ6%(CdTe).

Thus we showed that CQD were efficient down-shifters for photovoltaic applications. An enhancement of the quantum efficiency by about 4–8% was demonstrated in the 200–1100 nm optical range. Further work is required to optimize the QCD down-shifter in order to increase the overall power conversion efficiency of the solar cell. Using QCD with high QY can potentially increase the efficiency of SC by 20 %. Also the QCD down-shifter will play the role of an antireflection coating, and the reflection losses will be reduced. Therefore, the combination of antireflection coating and down conversion leads to increasing SC efficiency.

ВЗАИМОДЕЙСТВИЕ ФТОРИДА СКАНДИЯ С ФТОРИДАМИ ЩЕЛОЧНЫХ МЕТАЛЛОВ

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THE INTERRACTION OF SCANDIUM FLUORIDE WITH ALKALI METAL FLUORIDES

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Series of alkali metal fluoroscandiates were prepared by reacting corresponding individual fluorides MeF and ScF_3 (were Me was Li, Na, K, Rb, Cs) at 400–600 °C for 100 h under argon atmosphere. The Me : Sc ratio varied from 1 : 1 to 3 : 1. X-ray powder diffraction analysis showed that the following phases were formed: Li_3ScF_6, Na_3ScF_6, $NaScF_4$, K_3ScF_6, KSc_2F_7, Rb_3ScF_6, $RbScF_4$, Cs_3ScF_6, $CsScF_4$.

Неорганические фторидные материалы получили широкое распространение в оптике и люминесценции вследствие низкой энергии фононов и высокой пропускающей способности, что приводит к уменьшению нерадиоактивной релаксации по сравнению с оксидными или сульфидными материалами. Фтористые соединения щелочных металлов и редкоземельных элементов и скандия обладают уникальными свойствами, привлекающими внимание исследователей в течение последних лет. Скандий стоит особняком по отношению к РЗЭ и обладает наименьшим ионным радиусом и уникальной электронной конфигурацией, что придает скандийсодержащим соединениям более четкие оптические свойства. Однако сведения о свойствах фтористых соединений щелочных металлов и скандия ограничены.