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FeS2 thin films deposition by reactive high power magnetron sputtering in Ar+H2S gas mixture.

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Polycrystalline and nanocrystalline semiconducting iron pyrite FeS_2 is recently an attractive material for optoelectronic and photonic applications. Due to its relatively large optical absorption coefficient in the visible region and narrow band gap of 0.95 eV this material can be suitable for applications in photovoltaics, photodetectors and photoelectrochemistry. Semiconducting polycrystalline and nanocrystalline FeS_2 thin films were deposited by high power impulse magnetron reactive sputtering system (R-HIPIMS). The magnetron system with SmCo magnets and a pure circular iron target (diameter 50 mm) was used for the impulse reactive sputtering. The gas mixture of Ar and H_2S was used for the reactive sputtering process. The partial pressure of H_2S in the deposition plasma reactor was changed in a wide range. The substrate was heated during the deposition by an external furnace and the deposition temperature was controlled in the range 300-600 K. FeS_2 thin films were deposited at different magnetron pulsing frequency, magnitude of impulse power, substrate temperature and H_2S partial pressure. Some optimum deposition conditions were found and nanocrystalline and polycrystalline FeS_2 films were deposited by the reactive process. In order to improve semiconductor quality, FeS_2 films were annealed in sulphur vapors. FeS_2 films were deposited on single crystal silicon and SiO_2 quartz glass substrates. In order to be able to make photoelectrochemical measurements, FeS_2 films were also grown on Si substrate with Pt electrode and on glass with ITO electrode and TiO_2 anatase n-type semiconductor. FeS_2 films were characterized by Raman spectroscopy, SEM, EDAX, XPS and measurement of electrical conductivity. Films on Pt electrode and ITO/TiO_2 structures were studied by photoelectrochemistry in three electrode photoelectrochemical cell.

Keywords
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