Obtaining of FeS_2 thin films on glass substrates in gas discharge plasma

[1]E. Svitlichnyi, [2]A. Minya, [2]M.Pop, [2]R.Gritsak, [2]M. Feldii

[1] Institute of Electron Physics of NAS of Ukraine Universitetska str., 21, Uzhhorod,88017, Ukraine
E-mail:bercheni14@gmail.com
[2] Uzhgorod National University, Voloshin str. 56, 88000 Uzhgorod, Ukraine
E-mail:oleksandr.minya@uzhnu.edu.ua

The main methods for obtaining homogeneous thin films include thermal deposition of the material, magnetron sputtering, and chemical and electrochemical deposition methods. However, after the films are applied, chemical and thermal treatments are often necessary to improve their adhesion to the substrate, which can lead to uncontrolled changes in their physical properties. Thus, the search for alternative, simpler, and less resource-intensive methods of film deposition remains relevant. The aim of this work was to develop a methodology for depositing thin FeS_2 films on dielectric substrates (quartz glass).

In our experiments we used a universal gas discharge chamber shown in Fig.1 which consist of quartz tube 15 cm long, vacuum gasket, dielectric flanges, universal high-voltage inputs, Fe electrodes with adjustable interelectrode distance, heating element(optional) and pins for fixation. For sputtering we will use chalcogens located in the interelectrode space. Due the experiments, the voltage on the high-voltage rectifier was up to 5 kV, the average discharge current was up to 1 A, and the frequency of the pumping pulses was up to 10 kHz. Helium was used as a buffer gas, the pressure of which was 30 Torr. Crystalline sulfur was in the gas discharge chamber. The temperature of the mixture during the operation of the installation did not exceed 350 °C.

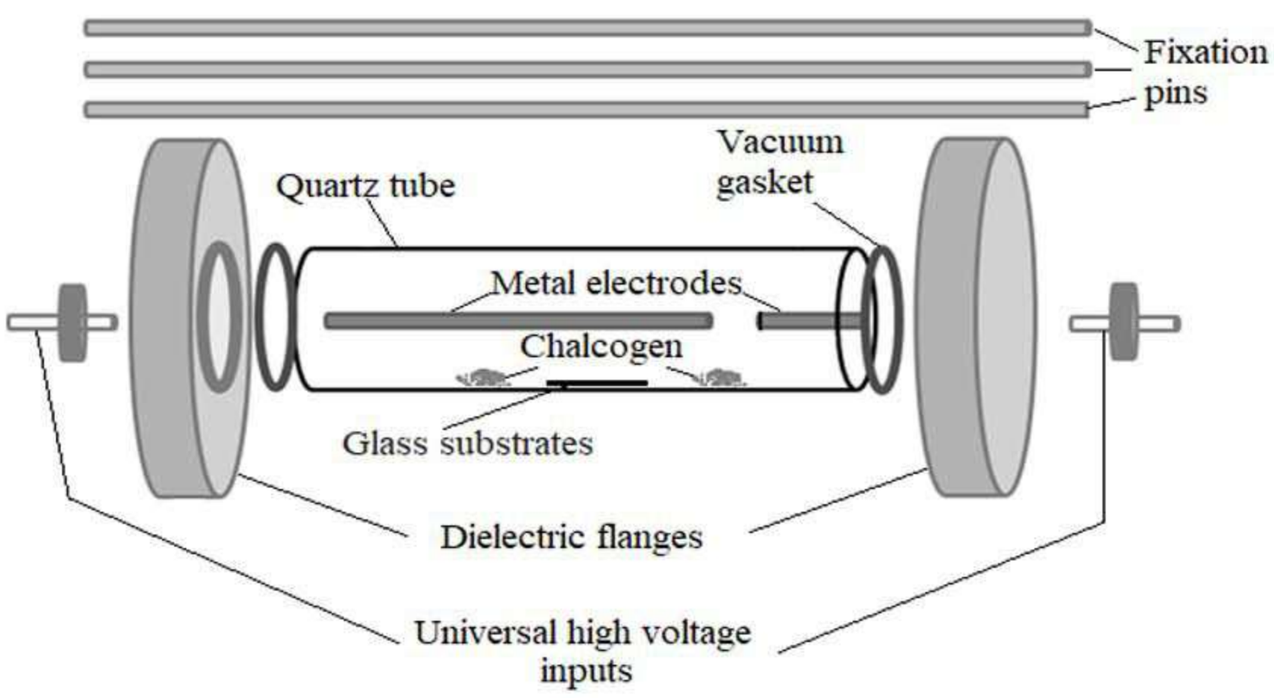

Fig. 1 Schematic of FeS_2 film deposition on glass substrates.

Fig. 2 Glass sample with a spraying film of FeS_2

A device and a method for applying FeS_2 films to the surface of dielectric glass substrates has been proposed and developed. The resulting thin FeS_2 films on dielectric substrates (quartz glass) without noticeable destruction of their surface are shown in Fig. 2.

Image of the surface of a glass substrates with FeS_2 film at 10x magnification shown in Fig.3 and the corresponding Raman spectrum with sulfur lines at 214 nm, 275 nm, 337 nm, and 362 nm. Exposure time 1 s, 20 scans, 10x magnification, 10% microscope laser power, laser wavelength 532 nm shown in Fig.4.

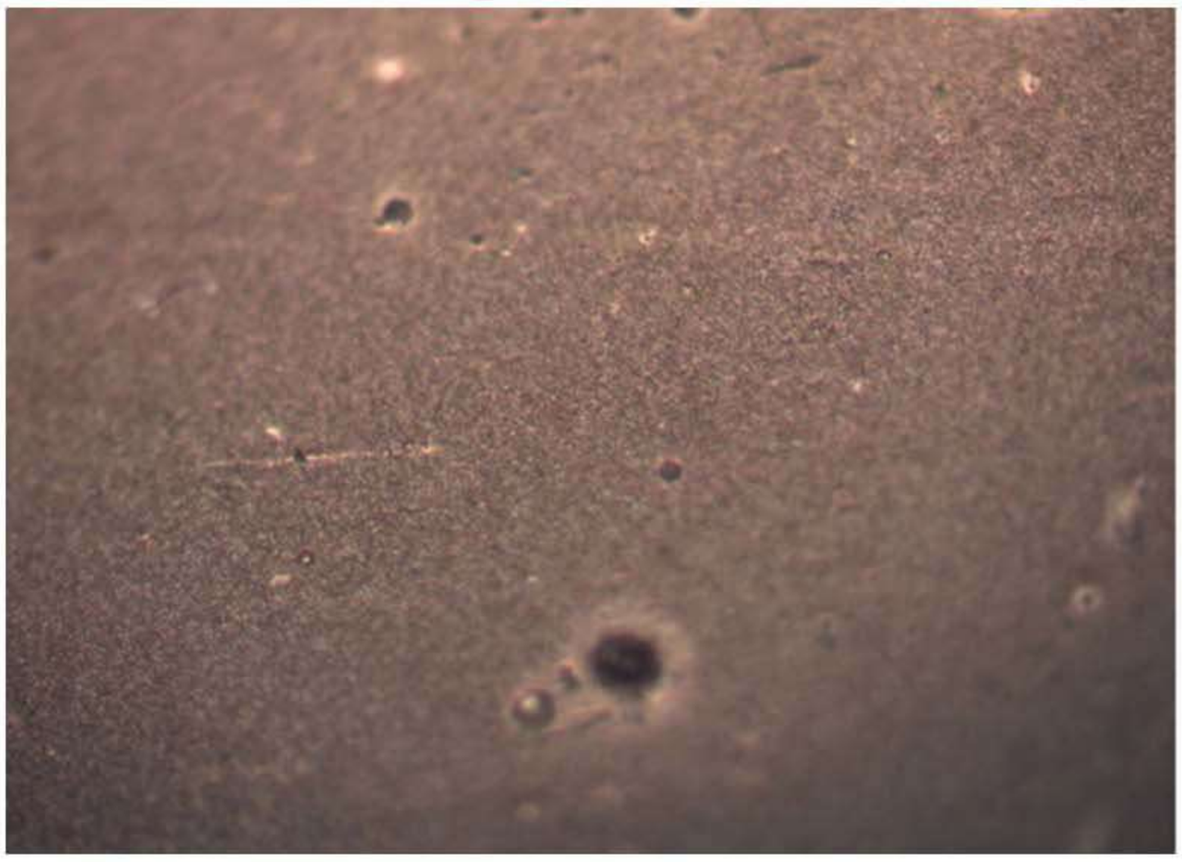

Fig.3 Image of the surface with FeS_2 film at 10x magnification

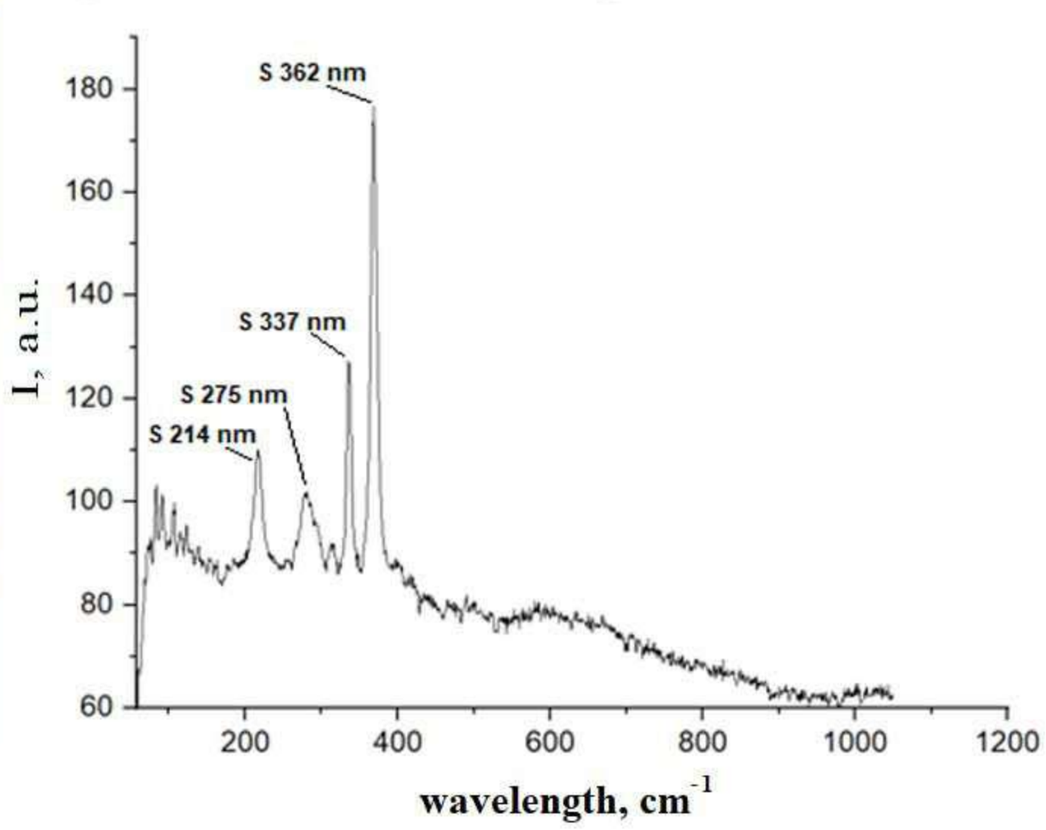

Fig.4 Raman spectrum with sulfur lines