Admittance of thin SiO_x(Si) and SiO_x(Si,Fe) composite films

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1.Goals and motivation

- Formation of electrical elements that act as micron and submicron sizes inductors.
- Optimization of technology for forming nanocrystals in SiO_x films.
- Investigation of charge transfer in composite structures

2. Experimental

- SiO_2(Si)&Fe_xO_y(Fe) films was obtained by IPS method with following thermal annealing .
- IPS-ion-plasma sputtering.

Parameters of deposition process:

P = 6.7×10^{-3} - 1×10^{-2} Pa), temperature of the substrate T = 100-150 ºC, the cathode heating current I_c=150 A, the anode voltage V_a = 50 V, anode current I_a = 10 A, target bias V = 1.1 kV, the current of target I_t = 0.6-0.7 mA.

- Thermal annealing:

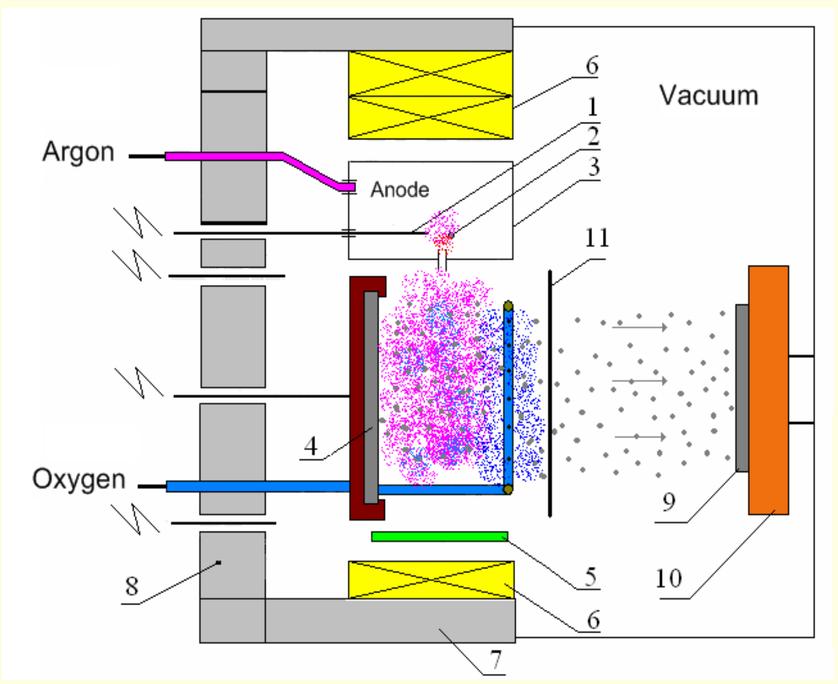
No annealing, T=673°C, T=773°C

- C –V characteristics:

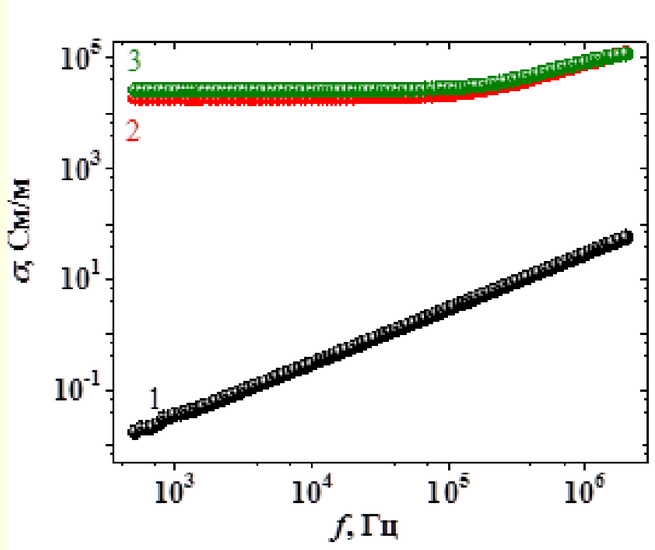
f =1 – 10 MHz

3. Results

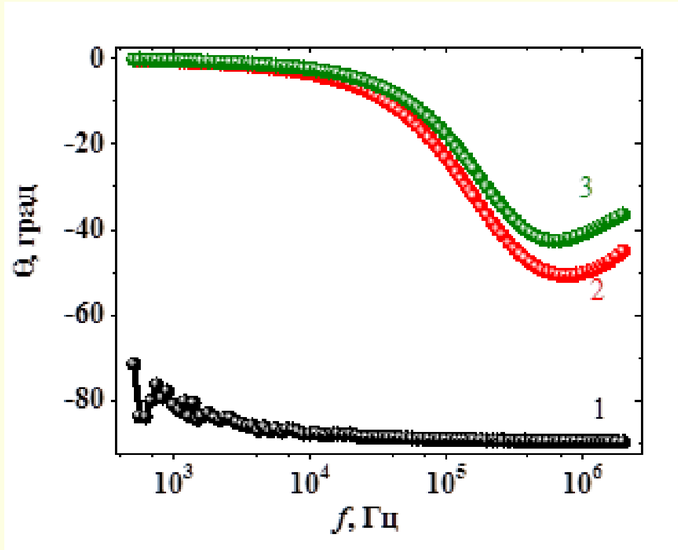
- Frequency *f* dependences of the phase shift angle *θ(f)* of the initial samples lie in the region of negative values, which indicates the predominance of the capacitive contribution in the admittance.
- The annealing significantly affects the shape of the curves *σ* (f) and *θ* (f).
- The low-frequency dependence *θ* (f) passes into the region of positive values, which indicates the predominance of the inductive contribution to the admittance at frequencies to the left of the minimum on the curves *σ* (f).
- This behavior of the dependences *σ* (f) and *θ* (f) of annealed samples with SiOx(Fe) film can be presented by equivalent circuits with the series connection of active and reactive contributions to the impedance.



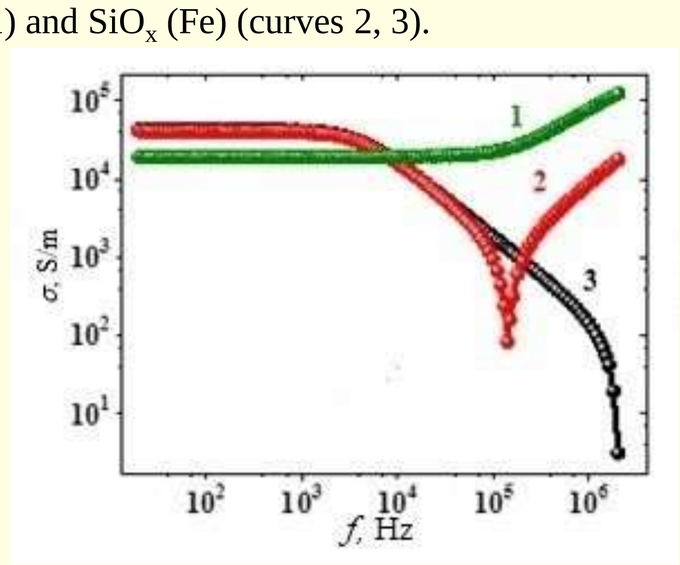
Ion-plasma sputtering (IPS) **:** 1 – Anode, 2 – Cathode, 3 - Discharge chamber, 4 – Target, 5 - Collector of ions, 6 – Magnets, 7 - Magnetic system, 8 – Flange, 9 – Substrate, 10 – Heater, 11 - Valve



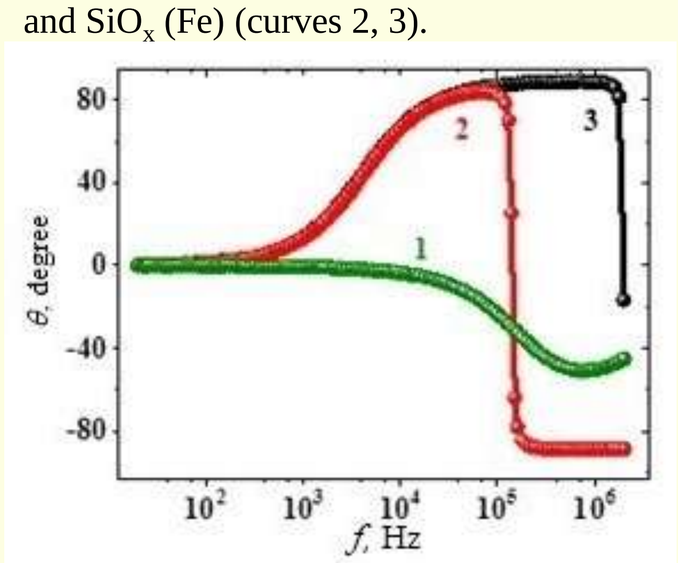
Frequency *f* dependences of the total admittance *σ(f)* for the composite thin films: Si/SiO_x (curve 1) and SiO_x (Fe) (curves 2, 3).



Frequency *f* dependences of the phase shift angle *θ(f)* for the composite thin films: Si/SiO_x (curve 1) and SiO_x (Fe) (curves 2, 3).



Frequency dependences of total admittance *σ(f)* for composite SiO_x(Fe) thin films, measured after annealing in air at different temperatures: 1 - before annealing, 2 - T_a = 673 K, 3 - T_a = 773 K.



Frequency dependences of phase shift angle *θ(f)* for composite SiO_x(Fe) thin films, measured after annealing in air at different temperatures: 1 - before annealing, 2 - T_a = 673 K, 3 - T_a = 773 K.