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PLASMA DEPOSITION AND ETCHING OF CARBON LAYERS FOR MICROELECTRONICS

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A b s t r a c t. This work shows results of investigation concerning optimalisation of deposition and etching of carbon layers (NCD – Nano Crystalline Diamond and DLC – Diamond like Carbon). The layers were produced with capacitance coupled a.c. discharges with frequency (RF – radio frequency). During the experiment aiming to MISFET transistor (Metal – Insulator – Semiconductor Field Effect Transistor) with carbon layer, activities were taken to determine properties of plasma and the layers. The layers were etched in reactor and aluminium mask was used. The influence of plasma etching on the layer and mask has been determined.

K e y w o r d s : plasma etching, thin carbon layers, aluminium masks.

THE EXPERIMENT

The parameters of carbon layers production in the first process (P3) were as fallow: pressure 250 mBarr, cathode autopolarisation 350V, CH_4 gas flow set on level 25ml/min. In the second process (P5) some parameters changed: cathode autopolarisation 210V CH_4 gas flow set on level 20ml/min.

The etching process was conducted in PLASMA LAB OXFORD 80+ with usage of capacitance coupled a.c. plasma and reactive ion etching. The parameters of etching were: pressure 10Pa, power 290W and CF_4 gas flow set on level 20ml/min.

RESULTS

Figures 1 and 2 show capacity –voltage characteristics of capacitors on produced diamond layers. A big convergence of results for different samples, as well as slight hysteresis of measured capacity in the inversion and accumulation direction can be observed.

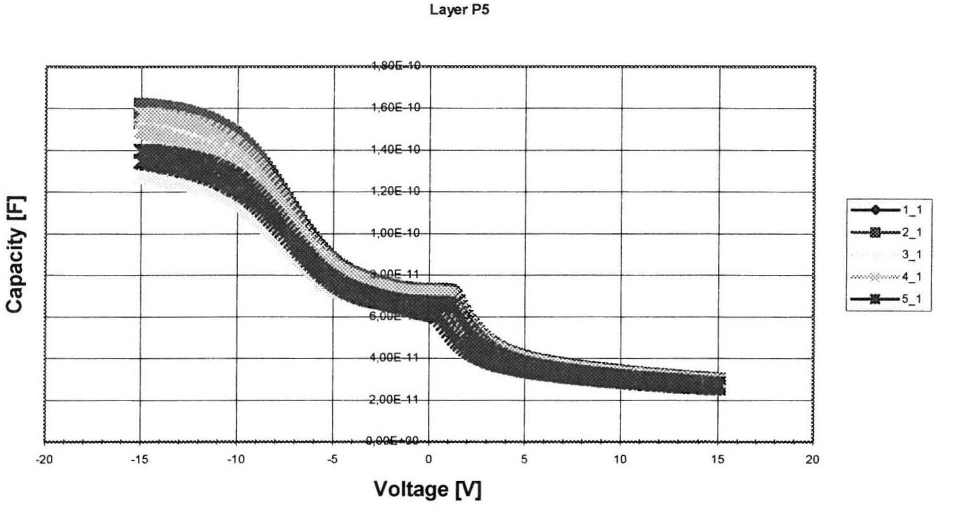

Fig. 1. CV characteristics of P5 layers in range −15 to 15V.

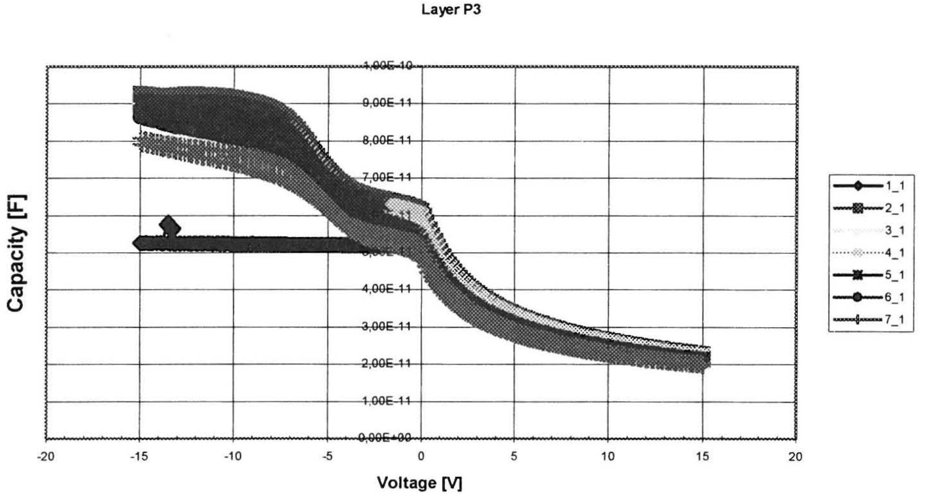

Fig. 2. CV characteristics of P3 layers in range −15 to 15V.

Figures 3 and 4 show IV characteristics for layers produced in the above-described processes. Symmetrical self-curing ruptures can be observed. However, they appear in voltage range having no influence on correct operation of produced devices. Figures 5 and 6 also illustrate attempts to perforate layers with high voltage, another ruptures occurred, nevertheless they do not completely damage the layers.

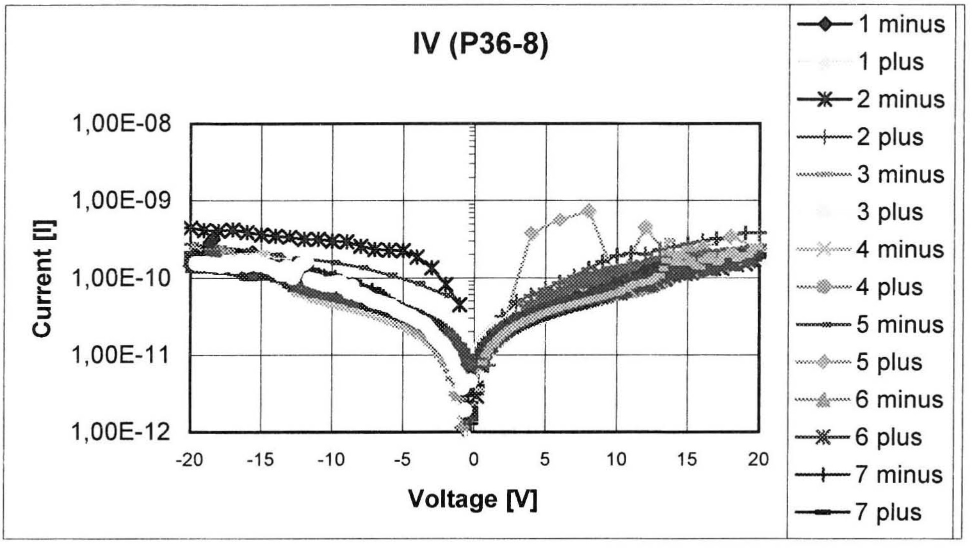

Fig. 3. IV characteristics of P3 layers in range – 20 to 20V.

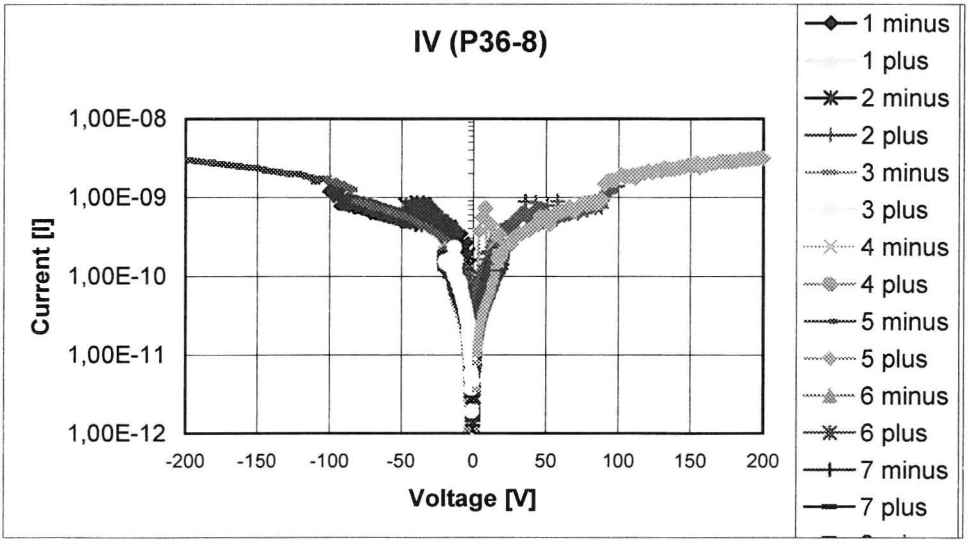

Fig. 4. IV characteristics of P3 layers in range – 200 to 200V.

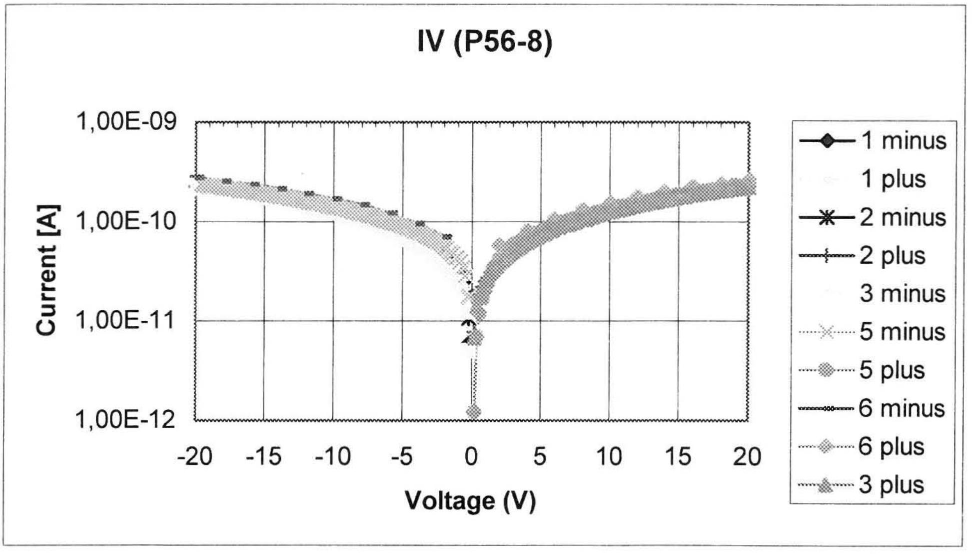

Fig. 5. IV characteristics of P5 layers in range – 20 to 20V.

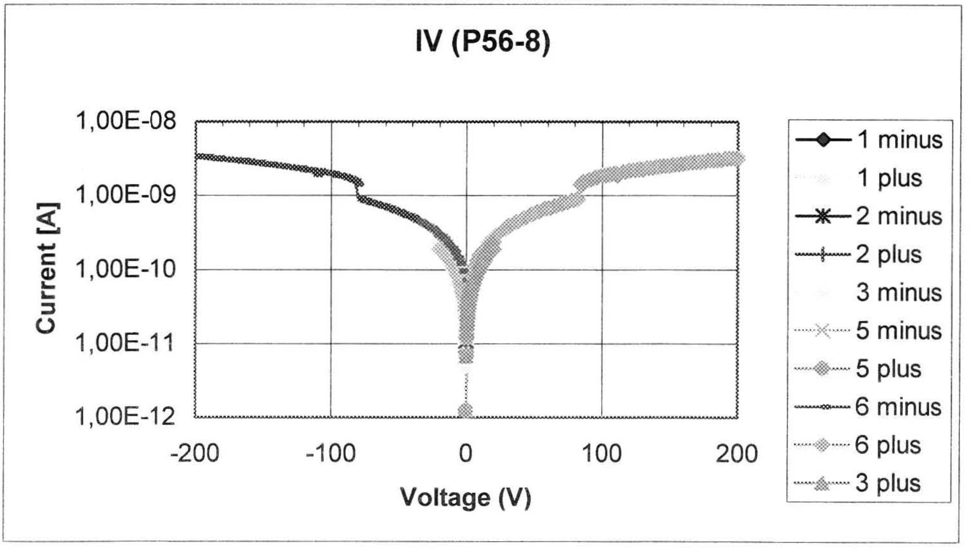

Fig. 6. IV characteristics of P5 layers in range –200 to 200V.

The obtained layers were etched with plasma parameters stated above. For mask aluminium was used – it can be later used in the process of devices production. The speed of etching was on level 790 ÷ 850 Å/min. It can be seen on Fig. 7 that the aluminium layer was not significantly damaged, as well as electrical properties haven't changed much, which has been proved in [9]. Hence, it can be used in next processes.

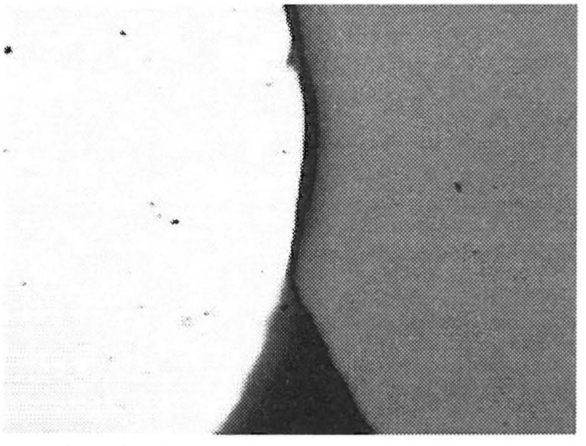

Fig. 7. Aluminium layer in partial (concealed with mechanical mask).

CONCLUSIONS

The conducted experiments enabled us to obtain homogeneous layers characterised by good surface adhesion, low defect density and resistance. As a result a technological process for producing the MIS capacitors was developed. During the investigation, quality of layers was evaluated on the basis of capacitors and final transistor electrical measurements. Using of the described method of producing and etching layers gives chances for its practical use in future to produce MIS and open gate transistors, which can be used as gauges in biomedical appliances.

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PLAZMOWE NAKŁADANIE I TRAWIENIE WARSTW WĘGLOWYCH DLA MIKROELEKTRONIKI

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S t r e s z c z e n i e. W pracy przedstawiono rezultaty badań dotyczących optymalizacji nakładania i trawienia warstw węglowych (nanokrystaliczny diament (NCD i amorficzny diament DLC). Warstwy wytwarzano metodą plazmy wysokiej częstotliwości (RF) w reaktorze o sprzężeniu pojemnościowym. W trakcie doświadczeń mających na celu wytworzenie tranzystora MISFET z warstwą węglową określono własności plazmy i powstających warstw. Określono wpływ trawienia plazmowego na powstałe warstwy i maski z aluminium.

S ł o w a k l u c z o w e : trawienie plazmowe, cienkie warstwy węglowe, maski aluminiowe.