

# Epitaxial Boron Nitride Processing and Conductivity

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Hexagonal boron nitride (h-BN) is a very promising candidate for optoelectronic applications in the deep ultraviolet spectral range due to its exceptional physical properties, such as high chemical stability, thermal conductivity and wide bandgap energy. A large cross section for neutron capture renders BN an outstanding candidate for neutron detectors.

In our experiments, we used h-BN grown on two inch sapphire wafers. Growth was performed via metalorganic vapour-phase epitaxy (MOVPE) [1,2]. High-resolution SEM images, X-ray and Raman studies indicate a very good quality of the obtained hBN layers. However, obtaining micro-scale devices on epitaxial h-BN layers is a challenge due to wet delamination that may occur during typical processing stages.

To address this issue, we present a novel preparation method of as grown h-BN layers prior to optical lithography. Our technique relies on the controlled delamination and deposition of the epitaxial layer that prevents unwanted delamination from the sapphire substrate during etching and metal coating processes and produces fewer wrinkles in the processed h-BN.

It enables multiple-stage processes, including etching and sputtering, on thin layers of epitaxial h-BN. Fig. 1 shows an example of a h-BN Hall bar processed with reactive ion etching and coated with metallic contacts made of an AuPd alloy.

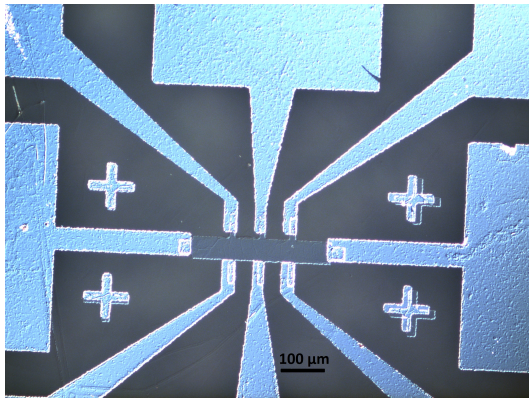


Fig 1. Optical image of a h-BN Hall bar structure with AuPd electrodes. The structure was created with a 2-stage lithographic process.

This novel preparation method allowed to study the effect of annealing of epitaxial h-BN layers in nitrogen atmosphere in the MOVPE reactor as well as the effect of irradiation with electrons in a scanning electron microscope (SEM). The electrical conductivity was measured before and after annealing and electron irradiation. The results show a significant increase in electrical conductivity after both treatments. These findings demonstrate the potential for controlling the electrical properties of h-BN, which is crucial for electronic and optoelectronic applications of epitaxial h-BN.

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[1] A. Dąbrowska, et al. 2D Materials 8, 015017 (2020)

[2] M. Tokarczyk, et al, 2D Materials 10, 025010 (2023)