



Designation: F 418 – 77 (Reapproved 1996)^{ε1}

Standard Practice for Preparation of Samples of the Constant Composition Region of Epitaxial Gallium Arsenide Phosphide for Hall Effect Measurements¹

This standard is issued under the fixed designation F 418; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

^{ε1} NOTE—Editorial changes were made throughout in February 1997.

1. Scope

1.1 This practice covers a procedure to be followed to free the constant composition region of epitaxially grown gallium arsenide phosphide, $\text{GaAs}_{(1-x)}\text{P}_x$, from the substrate and graded region on which it was grown in order to measure the electrical properties of only the constant composition region, which is typically 30 to 100 μm thick. It also sets forth two alternative procedures to be followed to make electrical contact to the specimen.

1.2 It is intended that this practice be used in conjunction with Test Methods F 76.

1.3 The specific parameters set forth in this recommended practice are appropriate for $\text{GaAs}_{0.62}\text{P}_{0.38}$, but they can be applied, with changes in etch times, to material with other compositions.

1.4 This practice does not deal with making or interpreting the Hall measurement on a specimen prepared as described herein, other than to point out the existence and possible effects due to the distribution of the free carriers among the two conduction band minima.

1.5 This practice can also be followed in the preparation of specimens of the constant composition region for light absorption measurements or for mass or emission spectrometric analysis.

1.6 This practice becomes increasingly difficult to apply as specimens become thinner.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For hazard statement, see Section 9 and 11.9.2.4.

2. Referenced Documents

2.1 ASTM Standards:

D 1125 Test Methods for Electrical Conductivity and Resistivity of Water²

F 76 Test Methods for Measuring Resistivity and Hall Coefficient and Determining Hall Mobility in Single-Crystal Semiconductors³

F 358 Test Method for Wavelength of Peak Photoluminescence and the Corresponding Composition of Gallium Arsenide Phosphide Wafers³

3. Terminology

3.1 Definitions:

3.1.1 *constant composition region*—as applied to epitaxial $\text{GaAs}_{(1-x)}\text{P}_x$, the layer last grown in which the composition is held fixed at about the desired value of x in mole percent phosphorus; x is typically 0.38.

3.1.2 *graded region*—as applied to epitaxial $\text{GaAs}_{(1-x)}\text{P}_x$, the layer first grown in which the composition is changed from GaAs to $\text{GaAs}_{(1-x)}\text{P}_x$ during the growth of the layer. The purpose of this layer is to minimize the lattice mismatch between the GaAs substrate and the $\text{GaAs}_{(1-x)}\text{P}_x$ layers.

3.1.3 *Hall carrier density*— $1/R_{H}e$ [cm^{-3}]⁴—the reciprocal of the product of the Hall coefficient and the electronic charge, a quantity related to the charge carrier density.

4. Summary of Practice

4.1 In this practice (1),⁴ a specimen is cleaved from a full wafer of $\text{GaAs}_{(1-x)}\text{P}_x$, the substrate is partially removed by mechanical lapping, the remainder of the substrate and the graded region are removed by chemical lapping, and the specimen is contacted either by welding or by flip chip mounting.

¹ This practice is under the jurisdiction of ASTM Committee F-1 on Electronics and is the direct responsibility of Subcommittee F01.15 on Gallium Arsenide.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ *Annual Book of ASTM Standards*, Vol 10.05.

⁴ The boldface numbers in parentheses refer to the list of references appended to this practice.