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Invited

Chemical Passivation of Compound Semiconductor Surfaces: Applications, Mechanisms and In Situ Probes

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The chemical passivation of III-V surfaces and optoelectronic devices by sulfides and selenides will be discussed. Performance in a wide range of devices (heterojunction bipolar transistors, surface emitting lasers, etc.) can be improved by this chemical approach. Recent experiments for example, show that even laser damage produced by electrostatic discharge can be eliminated by passivation of laser facets. In addition, photoluminescence is shown to be an ideal *in situ* technique for understanding the passivation mechanism.

INTRODUCTION

Chemical treatments based on aqueous sulfides and selenides are remarkably effective at passivating non-radiative defects on the surfaces of compound semiconductors. Though initially developed for treating GaAs surfaces, the use of these reagents has been extended to surfaces and devices based on virtually all of the III/V elements. As an example of the generality of these chemical schemes, I will discuss recent applications of surface passivation to the problem of electrostatic discharge damage in 1.3μ InGaAsP lasers. By chemically treating the facets of these lasers we have been able to increase the mean failure voltage of the devices more than 400%.

I will also discuss how *in situ* photoluminescence spectra obtained from GaAs samples contained within an MBE chamber provide new insights into the passivation mechanism. The improved laser reliability and in situ photoluminescence experiments underscore the importance of oxide removal and the formation of strong S(Se)/semiconductor bonds in the passivation mechanism.