Sensors and Materials, Vol. 6, No. 6 (1994) 319-332
MYU Tokyo

S & M 0175

Fluidic Self-Assembly of GaAs Microstructures on Si Substrates

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(Received January 6, 1994; accepted April 16, 1994)

Key words: fluid transport, self-assembling microstructure, gallium arsenide, optoelectronic integration

A new technique for the self-assembly of microstructures is demonstrated in this paper. Microstructures are freed from their substrate by sacrificial etching techniques. They are then transferred into an inert carrier fluid and assembled onto a host substrate by fluid transport. Before the microstructures are freed, they can first be bonded to an intermediate substrate. Their original substrate is removed by selective etching to provide access to the other side of the microstructures for processing. The microstructures are fabricated with specific binding features. The carrier fluid is dispensed onto a host substrate with specific receptor features to control the positioning and the orientation of the devices. This technique is well suited for the integration of microstructures on substrates made of incompatible material systems, *e.g.*, GaAs on Si. GaAs light-emitting diodes have been integrated into holes etched into single-crystalline Si substrates, which successfully emit infrared radiation under electrical bias. GaAs resonant-tunneling diodes have also been similarly integrated on Si and exhibit negative-differential resistance behavior and rf oscillations.

1. Introduction

Conventional micromachining techniques which utilize thin-film layer deposition and etching processes severely limit the types of micromechanical devices that can be fabricated.[1,2] This is especially true when the geometry of the device structure or the incompatibility of the material systems prohibits fabrication by these techniques. Self-assembling microstructures, in which the devices are assembled into place after processing, provide