Novel guided fluidic assembling technologies for optical devices

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Abstract

Self-assembling of micro size devices is an indispensable technology for several industrial and biomedical applications. High precision assembly of the laser diodes (LDs) and the Light Emitting Diodes (LEDs) on silicon wafer substrates for their use in advanced optoelectronic devices is an important issue from a mass production point of view. An acceptable alternative to replace an obsolete pick and place flip chip bonding robotic technology with a simple, low cost and high speed technique is desired for industrial applications. We have investigated a novel assembling technique with micrometer order accuracy for LD microchips. Its feasibility for rapidly assembling a large number of high power edge emitting LDs is practically demonstrated. A 150 micro meter thick nickel metal mask is used to confine as well as guide the unassembled LDs into their recesses by its restricted displacements. This technique is based on guiding the LDs within a suitable fluidic medium to perform the assembling process in two steps: (i) coarse precision with a confinement mask to bring LDs near their recesses to achieve high assembling efficiency and (ii) fine precision due to their electrode patterns on the base surface of LDs, under fluidic as well as gravitational force. The assembly of 80 red LDs of the same size and of 40 pairs of red and infrared LDs of two different sizes is successfully demonstrated within less than +/- 2 micrometer precision and 100% efficiency in a few seconds after transferring all LDs into their confinement mask regions. Further technological issues in the advanced optical devices self-assembly for their optical and biomedical applications will be discussed.