UNIVERSITY OF MINNESOTA
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Programmable Self-assembly Method for Nanocomponents and Microcomponents

IP Status: Issued US Patent; **Application #:** 11/686,137

NanoComponent and MicroComponent Directed, Programmable Self-Assembly

Programmable self-assembly is a breakthrough directed self-assembly method that enables low-cost, highly consistent and high volume manufacturing of complex meso systems and devices (optical and fluidic, integrated circuits, sensors, actuators). Programmable self-assembly enables batch integration both in two and three dimensions, is highly parallel and works up to 1000 times faster than robotic manufacturing.

Programmable self-assembly is scalable and forms electrical interconnects between micrometer and potentially nanometer sized components which allows the resulting nanocomponents to be 10-100x smaller.

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- Trial fee is $5,000 for a six month license

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- $30,000 conversion fee (TRY to BUY)
- No patent costs
- Royalty rate of 3% (2% for MN company)
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Liquid Solder Receptors

The self-assembly-by-design concept uses patterned surface areas (receptors) to attract and electrically connect device components to form a functional device. The interaction driving the self-assembly is based on capillary forces between liquid solder drops and correspondingly shaped metallic binding sites on the components. Geometrical shape recognition is used to identify non-identical components which allow rapid reconfigurations by merely redesigning receptors that direct the assembly process (rather than reprogramming robots). Metal contacts on the semiconductor devices bind to the liquid solder-based receptors on a substrate surface during fluidic self-assembly. Different from existing concepts, the proposed self-assembly-by-design tool will be programmable, which means that selected receptors can be activated using an external voltage and assembled using the current CMOS manufacturing infrastructure.

Microelectronic and Optoelectronic Applications

This technology platform has applications in the production of current electronic devices such as integrated circuits, radio frequency identification (RFID) tags, optical and photonic devices,

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sensors, actuators, displays, and fluidic devices.

FEATURES AND BENEFITS OF PROGRAMMABLE, RECONFIGURABLE SELF-ASSEMBLY:

- Works in two and three dimensions, is highly parallel, and much faster than robotic manufacturing.
- Programmable and enables batch integration of different devices (i.e. different sources out of varying materials).
- Allows rapid reconfigurations by reprogramming receptors that direct the assembly process and makes use of the current CMOS manufacturing infrastructure.

Phase of Development Proof of concept complete. Six hundred AlGaInP/GaAs light-emitting diode (LEDs) segments self-assembled onto device carriers in 2 minutes without defects. Encapsulation units self-assembled onto the LED-carrier assemblies to form a three-dimensional circuit path to operate the final device.