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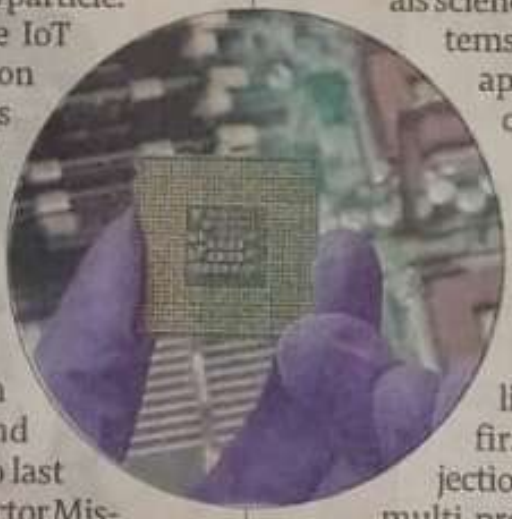
Making chips intelligent

V RAMGOPAL RAO

A 3-NANOMETRE TRANSISTOR is no longer science fiction; it is inside the phone in your pocket. Yet classical silicon is gasping. The next leap will come from nanoelectronics: new materials, new device physics, and integration at atomic precision. This includes today's scaled CMOS (complementary metal oxide semiconductor) powering everything from AI chips to edge devices.

This is not just about making chips smaller. It is about making them smarter, cheaper, and greener. The global nanoelectronics market, encompassing scaled CMOS semiconductors, sensors, and IoT edge devices, is heading toward $1 trillion by 2030. Nanosensors already detect a single virus particle. Ultra-low-power chips enable IoT networks that run for ten years on a coin cell. Flexible electronics printed on plastic will turn any surface into a display or a health monitor. From electric-vehicle powertrains to satellite constellations, every high-growth sector rides this wave.



India spends over $25 billion every year importing chips and sensors. That number rose 18% last year alone. The India Semiconductor Mission is building fabs and assembly plants, but fabs alone will not stop the outflow. Real sovereignty lies in owning the frontier: compound semiconductors, MEMS sensors, integrated photonics, and IoT edge intelligence. Redirect at least one-tenth of the mission's budget to nanoelectronics R&D and we can create a few billion dollars in high-value exports by 2035.

Science funding is the bottleneck. India's gross expenditure on R&D remains stuck below 0.7% of GDP, lowest among even the BRICS countries. Our universities and institutes run nano labs on shoestring budgets. The Anusandhan National Research Foundation (ANRF) was created to change that, but it needs to move faster and bolder when it comes to semiconductor R&D investments. A dedicated funding window for nanoelectronics and sensor missions, split between large consortia and high-risk academic projects, would ignite hundreds of translational efforts overnight.

Talent must follow money. We produce 1.5 million engineers annually, yet most have never seen a clean room. Curricula must fuse materials science, device physics, and data systems from the second year. Industry apprenticeships, faculty sabbaticals in fabs, and mandatory six-month internships should become non-negotiable.

Ideas must reach market. Nanoelectronics is capital-intensive. We need pre-competitive consortia, university-linked seed funds that write the first crore without revenue projections, and government-sponsored multi-project wafer runs for startups.

India has a narrow window to lead in sensors and IoT edge intelligence, two segments where software strength meets hardware opportunity. We have the mission, the minds, and the market. All that is missing is the courage to fund science at scale. The devices are shrinking. Our ambition must not.

The writer is vice-chancellor, BITS Pilani Group of Institutions