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News & Analysis

UC Berkeley Scientists Advance On-Chip Inductor Technology

Ismini Scouras

3/20/2014 09:00 AM EDT

6 comments

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University of California Berkeley scientists say they have found a way to advance on-chip inductor technology, triggering a new generation of miniature RF electronics and wireless communications systems.

The UC research delved into recent developments in nanomaterial synthesis of nanomagnets. Liwei Lin, a professor of mechanical engineering at UC Berkeley, told us the researchers found that using magnetic nanoparticles with a coating of insulators shrinks the size and improves the performance of high-frequency on-chip inductors. "They provide good magnetic permeability with high cutoff frequency while reducing the eddy current losses at high-frequency operations."

Engineers have had problems trying to reduce the size of on-chip inductors while maintaining optimum levels of inductance and performance. Difficulties stem from limitations set by "fundamental sciences and constraints set by engineering practice," Lin said.

On-chip inductor technology hasn't progressed the same way as transistor technology, which has followed Moore's Law over the past 40 years. Inductors -- technically passive elements in circuitry -- fall into the "More Than Moore" domain, in which devices integrate nondigital functions such as RF and MEMS that do not scale to Moore's Law.

When on-chip inductors are constructed, large areas are required, because they need a certain length, number of turns, thickness, and space between metal traces to achieve adequate levels of inductance and performance. However, the large area requirements produce inductance losses because of the parasitic effects between the spiral coil and the semiconductor substrate.

As a result, miniaturization will require the addition of magnetic materials, but they have their own technical limitations, "such as processing schemes, compatibility with standard processes, and material stabilities," Lin said. "Magnetic materials have fundamental limits on their permeability and frequency responses."

The new inductor fabrication technology, which uses insulated nano-composite magnetic materials as the filling material to reduce the size of the on-chip inductors, enhances inductance by up to 80%, resulting in at least 50% shrinkage in the on-chip inductor. It also has the potential to extend the operational frequency range from the GHz range to the 10-GHz range, Lin said.

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lakehermit A few years ago there was a well respected Federal Judge was trying to address a similar situation. Unfortunately he was well up in years and didn't really understand modern technology....

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12:06:38 PM

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He expects these advancements to be applied to the chip manufacturing process in 3-5 years.

The UC Berkeley research has been sponsored by Semiconductor Research Corp., the university research consortium for semiconductors and related technologies in Research Triangle Park, N.C.

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Really a great research
Kinnar 3/24/2014 6:02:53 AM

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USER RANK
CEO

It is really a very nice finding by UC Berkeley Scientists this will help integrate more RF Circuits using silicon and nano magnetic material. Now this will require few more steps to find how to use the nano magnetic material in the IC

Fabrication process with necessary modifications in the fabrication equipments.

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Re: Other work?
JanineLove 3/20/2014 5:25:20 PM

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USER RANK
BLOGGER

For some reason y'all is so much more appealing to me. Not like fingernails on a chalkboard (sadly, my kids probably wouldn't get that reference...)

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Re: Other work?
Bert22306 3/20/2014 5:22:55 PM

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USER RANK
CEO

Y'uns, how could I forget. Y'uns is the "grammatical" equivalent of the southern y'all. It is the plural of you, because we have all forgotten by now that the singular of you is thou.

Y'uns must mean "you ones."

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Re: Other work?
JanineLove 3/20/2014 5:19:25 PM

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USER RANK
BLOGGER

Glad you appreciated that Bert! I did some substitute teaching while in Pittsburgh and it was a real social awakening. Having grown up in NJ, I didn't expect people from PA to have such a different way of speaking. (I was used to weirdisms from eastern PA, like "throw grandpa down the stairs his hat," but having a really different phonetic lexicon was a surprise.) The thing that bugged me the most was yu'ns for you. Oh, that and the fact that my students thought the Univeristy of Delaware was in NJ, but that's another story...Having been working in the microwave industry since 19cough cough, I'm really glad that inductors are getting some attention. Looking forward to seeing what's next!

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Re: Other work?
Bert22306 3/20/2014 4:51:37 PM

NO RATINGS
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USER RANK
CEO

Janine, I'm still laughing out loud about your "redd up dahn tahn" comment. It's just too funny. My wife used to teach up in Butler County, north of Pittsburgh, and that's exactly how the locals sound. They also have some grammatical oddities. Like for instance, "This needs to be fixed" becomes "this

Flash Poll

Will Moore's Law ever hit bottom (i.e., will it end)? If so, when?

- It's dead now
- Yes, at 28nm
- Yes, at 14nm
- Yes, at 7nm
- Yes, at 5nm
- No, graphene will keep it alive
- No, 3D stacks will extend it
- No, it will never end
- Other (specify in the comments below)

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needs fixed." And "Is that as much as you've completed?" becomes "Is that all the more you've completed?"

Anyway, this issue with inductors on chips has been a problem from way back. It's basically a mechanical problem. So this is indeed good news, if high tech magnetic materials can be stuffed between the coils to reduce the size of the inductor. What people often do now is stay away from inductors, using RC circuits instead to emulate the behavior of an inductor.

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Other work?
JanineLove 3/20/2014 9:52:59 AM

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This is great to see. Anyone else doing work in this area?

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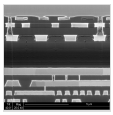
Daniel Morris @danielm_eCos 1h
So much choice to #EELive Stayed up late for 2hrs on Fri nights to hear little band from #sheffield growing up in UK pic.twitter.com/QHW3JFsAMC

Top Comments of the Week

Intel leading: Good to read that Intel is still pushing the boundaries for others to follow. The only concern is Intel's inability to break the ranks of the...
wilber_xbox on Intel's Custom Chips ...

Re: Intel Cost Slides: Sang Kim
Moore's Law predicted in 1965 was fulfilled b
Moore's prediction
in my opinion was based on the bulk silicon technology that ends at 28nm and not
michigan0 on 28nm – The Last Node ...



Intel's cost per transistor different: Intel's Mark Bohr shows cost per transistor scaling for them upto 10nm. However, fabless vendors like nVidia and Broadcom have been complaining...
3D Guy on FinFETs Not the Best ...

Re: Another successful score...: Junko, you (and Bert) are right on target!!! The DOJ is most certainly avoiding the electronics issue, this has been one of my major concerns,...
Parris Boyd on Toyota Pays $1.2B to ...

Re: Another successful score...: Junko, You are not wrong. You are right. The docs I got in the translation project for Debevoise & Plimpton, Toyota's defense law firm representing...
B. Benjaminson on Toyota Pays $1.2B to ...