Distributed Constant Passive Devices Using Wafer-Level Chip Scale Package Technology for One-Chip Wireless Communication Circuits

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Wireless Communication Technology

mobile-phone, RF-ID, Wireless LAN, GPS, Bluetooth

Demands { Miniaturization, Low-price

Analog RF and digital circuits are implemented on the same chip.

- Reduction of discrete devices
→Miniaturization and Low-price
- Interconnections between chips are unnecessary.
→Low-power-consumption
- ・・・There are a lot of merits.

Si CMOS Process

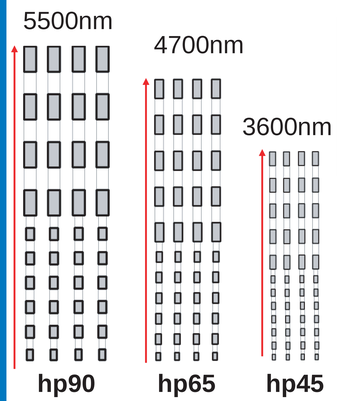
GHz RF circuit :
Compound semiconductors have been used.

Si CMOS process
- Low-price
- Mixed-Signal chip
- Improvement of f_T of transistors by miniaturization realizes GHz RF circuits.

Miniaturization
→The operating frequency can be increased over 20GHz.

Low-price and small wide-band communication circuits and radar can be achieved by Si CMOS technology.

Problems of Si CMOS Process



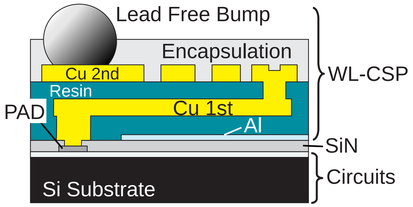
Miniaturization = Speed up

1. Wires become thin.
⇔ Wiring resistance is increasing.
2. Transistor achieves higher f_T.
→Loss of Si substrate cannot be neglected over 10 GHz.

Mixed-signal chip:
It is impossible to use thick wiring and dielectric layer.

Process progress
= Characteristics of passive devices become worse.
・・・unavoidable problem

Proposal

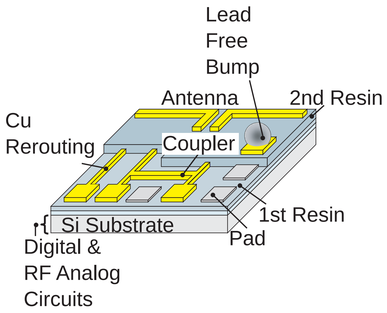


Use of wafer-level chip scale package (WL-CSP) technology[1] for one-chip wireless communication circuits.

- Packaging process is performed at a wafer-level process prior to the dicing process.
- The package size is equal to the chip size.

WL-CSP { Low price
Thick metal & dielectric layer
= Low-loss passive device

An image of proposed circuit



When a signal wavelength becomes the same order as a chip size, on-chip distributed passive devices can be realized.

It is possible with the Si CMOS and WL-CSP process to achieve small-size, low-price and low-power-consumption microwave wireless communication circuits that have all functions for wireless communication : antennas, couplers, RF analog and digital circuits.

[1] K. Itoi, et al., IEEE MTT-S IMS, 197-200, 2004.