Fiche de poste doctorat - Cadre du programme IPCEI ME-CT

Intitulé du poste	Offre de Thèse - Packaging of active millimetre band measurement probe (H/F)
Informations générales	lieu : IEMN, Cité Scientifique, Avenue Poincaré 59652 Villeneuve d'Ascq Contrat à durée déterminée de 3 ans Nov 2023 – Oct 2026 Financé par contrat IPCEI ME-CT projet Échelle des salaires du CNRS (IE niveau II 2135€ brut par mois)
Missions	The most recent developments in telecommunications and ultra high data rate transfer have been considerably boosted by the rise of Cloud Storage and Computing and the development of the 5G telecommunications standard. Intimately linked to the emergence of artificial intelligence (AI), sensor networks (IoT), data processing and storage, one of the challenges to be met is the transition to data rate in excess of 100 Gb/s. This can only be achieved by developing millimetre band (mmW) technologies, components and systems. Advanced silicon technologies (BiCMOS) targeting cut-off frequencies ft/fmax above 400GHz will enable silicon circuits to be designed in the 140-220GHz frequency range (G-band). In order to validate the development of these technologies, microwave characterisation tools are needed to extract transistor figures of merit such as noise figure and power efficiency, and to develop the associated modelling. At these frequencies, broadband tools such as noise sources, noise receivers, impedance adapters (tuners) and power receivers are either not available on the market or have characteristics that vary greatly over the frequency band. Previous work has shown that it is possible to carry out noise measurements in D-band (110-170 GHz) and G-band (140-220 GHz) by embedding the measurement instrumentation directly on silicon close to the component to be tested in BiCMOS technology. In other words, it is possible to measure component noise in CMOS or BiCMOS technology by integrating the noise source, the tuner and even the noise receiver in the direct vicinity of the component on the same silicon chip and in the same process technology. However, this built-in self test (BIST) approach is not a viable solution because it consumes a substantial area of silicon, resulting in an unacceptable cost. In order to take advantage of measurement instrumentation for all types of technology and to rationalize the costs associated with testing, the next step is to integrate these functions into a compact system positioned as close as possible to the measurement needles. The proximity of the instrumentation function (e.g. noise source) to the immediate vicinity of the contact needles on the wafer is necessary in order to control losses which drasmatically affect measurement sensitivity. This measurement system must be produced using a packaging technology that includes the manufacture of the needles so that the components can be tested directly on the silicon wafers. This instrumentation system therefore takes the form of a functionalised active probe requiring the implementation of a packaging technology optimised for millimeter wave frequency bands. In this context, this project proposes to tackle packaging in the mmW regime by integrating the measurement instrumentation as close as possible to the needles intended for on-wafer measurements. The main objectives of this thesis are as follows:

	1) Development of a passive GSG probe technology based on the implementation of a glass substrate integrating a coplanar line and an E-planar probe making the transition to a standard WR5.1 rectangular waveguide. Based on a 30 µm thick glass dielectric core, it is expected to be able to demonstrate a measurement probe configuration with two substantial advantages: i) robustness to apply sufficient force to minimise contact resistance and ii) elimination of volume spurious modes and associated losses. This work includes the implementation of probes in a G-band measurement situation on simple calibration substrate structures (ISS). 2) The final objective is to design and manufacture an active measurement probe integrating the measurement chain elements in the immediate vicinity of the contact needles used in on-wafer measurement. The manufacture of this type of package involves femtosecond laser machining techniques, enabling micron dimensions to be achieved.
Activités	The following tasks will be considered: - Design and electromagnetic simulation of complex waveguide structures (e.g. flange-bend-transitions coplanar/rectangular) using Momentum or CST codes. - Parametric study of laser micromachining on dielectric and metallic materials - Analytical characterisation of micromachining processes (SEM, optical profilometry, XPS, EDX, etc.) - Assembly and microwave measurements of designed structures - Benchmarking and positioning of results in relation to the state of the art
Compétences attendues	This position is aimed at a candidate interested in microfabrication and modelling/simulation in the field of electromagnetism (RF, mmW). Potential candidates must: - Hold a master's degree in electronics or microwave engineering. - Preliminary knowledge of microfabrication, cleanroom techniques and/or laser applications may be useful - Be fluent in English (spoken and written) and have a proven track record in writing reports and publications. - Ability to work independently and take initiatives - Integrate group work and the dynamics of a joint laboratory
Contexte du travail	The work will be carried out in the Silicon Microelectronics group at IEMN (Lille-France) as part of the joint IEMN-STMicroelectronics laboratory. The group hosting the candidate has recognised expertise in the micro-nanofabrication and packaging of components and systems covering RF and mmW.
Contraintes et risques	Short-term travels in France and abroad (project meetings, conferences....)
Informations complémentaires	