7 December 2021

QUOTATION

INESC MN
Microsystems and Nanotechnologies

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IOPCAS-BEIJING will pay INESC-MN for the completed design and development of TMR Sensors as per the SOW, in the amount of One Hundred Thousand Euro (100,000 €), in two milestone payments. INESC-MN will send invoice to IOP-BEIJING according the schedule herein. Invoice will be paid by IOP-BEIJING in Euro within thirty (30) days after receipt of an electronic invoice from INESC-MN. The following quotation is available before Jan. 31. 2022.

a. Euro 50,000 (50% of 100,000 €) with the signature of the Cooperation Agreement, for sensor optimization and test.
b. Euro 50,000 (50% of 100,000 €) on the Deliverable of 40 TMR sensor wafers and technical description.
c. Sensor performance will be evaluated in a best effort basis. The Parties should agree on the acceptance conditions in the SOW.
d. Additional wafers with TMR sensors to be sourced from INESC-MN shall be Euro 1,500 per wafer.

Annex A - Statement of Work (SOW)

Development of MTJ sensors at INESC MN will be done in two phases:

Phase 1 - TMR sensors with direct and indirect double pinned MTJ structures will be optimized with the structures:

[Ta/Ru]3/PtMn/CoFe/Ru/CoFeB/MgO/CoFeB/NiFe/Ru/IrMn/Ta/Ru
Or similar indirect & direct double pinned structures optimized at INESC-MN.
The full bridge chip size is as small as possible.

The specifications of the optimized devices are:
(1) Full bridge Resistance：10 kΩ～50 kΩ;

Sensitivity：5～10 mV/V/Oe;
Offset voltage：min -5 mV/V，max 5 mV/V；
Field noise level (Detectivity): ～1 nT/Hz^(1/2)@1Hz;
Non-linearity: <0.5%;
Saturation field: >100 Oe;
Hysteresis: <0.5 Oe @±80 Oe@25℃;
Uniformity: >95%;
Bandwidth: DC～1 MHz;
Temperature Coefficient of Resistance <600 ppm/℃;
Temperature Coefficient of Sensitivity <300 ppm/℃.

(2) Full bridge Resistance：10 kΩ～50 kΩ;
Sensitivity：0.1～1 mV/V/Oe;
Offset voltage：min -5 mV/V，max 5 mV/V @±200 Oe；
Field noise level (Detectivity): ～1 nT/Hz^(1/2)@1Hz;
Non-linearity: <0.5%;
Saturation field: >500 Oe;
Hysteresis: <0.5 Oe @±200 Oe@25℃;
Uniformity: >95%;
Bandwidth: DC～1 MHz;
Temperature Coefficient of Resistance <600 ppm/℃;
Temperature Coefficient of Sensitivity <300 ppm/℃.

The sensors will be optimized at test sample level, including magnetic and transport characterization. The test samples will be available to IOP-BEIJING, together with the reports.

Phase 2 – TMR wafer production - A microfabrication process will be developed for 6 inch or 8 inch wafers. The objective is to demonstrate a full wafer process capability, with high yield (> 90% functional devices) and within the specifications.

Deliverable: INESC-MN will provide up to 20 wafers of 6 inch and 20 wafers of 8 inch with the optimized stacks and design.

Assinado por : **Susana Isabel Pinheiro Cardoso de Freitas**
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CHAVE MÓVEL

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