Microfabricated Inductive Sensor for Position Measurements

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Introduction

Inductive sensors are nowadays very common in industrial applications. Their main advantages in comparison to other kind of sensors are small price, resistance to environmental influences, and being compact. A MEMS based inductive sensor exhibits a high degree of miniaturization and integration [1,2]. The institute for microtechnology (imt) has developed a new inductive micro position sensor. This device represents a combination of the transformer principle with a mobile core and a variable reluctance (VR) [3].

Design

The design of a micropositioning sensor was obtained by a finite elements method (FEM) analysis. The structure of the micro sensor is shown in Figure 1. It is made up of a stator and a traveler. The stator contains the primary part with a coil exciting the system and secondary parts with a pair of sensing coils for measurement. The sensor consists particularly of an array of transformers. The stator is composed of E-shaped magnetic yokes, a double turn meander coil, and two multiturn double layered spiral coils. The meander coil is excited by an alternating current and creates an alternating magnetic flux. The traveler contains an array of magnetic yokes with a well-defined distance from each other representing the scale. These yokes are closing the flux between the transformer's primary coil and the two secondary coils.
FEM performed 2-D electromagnetic simulations resulted in an induced voltage output signal of 18.8 mV. These values refer to an excitation current of 150mA.

Fabrication Process

The sensor's functional elements are fabricated on silicon wafers using UV depth lithography and electroplating. Traveler and stator are fabricated on separate wafers. The materials employed are NiFe81/19 for the poles and yokes, and cooper for the coils. As insulation material a photosensitive epoxy (SU-8) was used. To achieve constant magnetic layer thicknesses as well as flat surfaces, chemical-mechanical polishing (CMP) was applied. The height of the sensor with double layer coils and magnetic flux guides is 45 µm.
Figure 2 presents a SEM micrograph of a first version of a completed stator. In comparison to an enhanced design with double layered sensing coils, this device contains one coil. The coil's second layer consists of a return meander (excitation coil) as well as of electrical connections (sensing coils). The dimension of the stator is 1mm x 3mm. Figure 3 shows a micrograph of the complete traveler with dimensions of 0.6mm x 4.5mm.

Conclusion

A new kind of inductive micropositioning sensor was developed. Following the completion of the sensor, electrical and magnetic properties will be evaluated.

Acknowledgement

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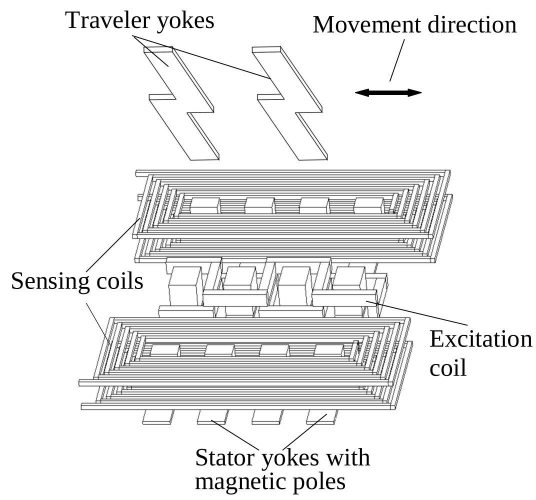

Fig 1: Schematic illustration of the micropositioning sensor

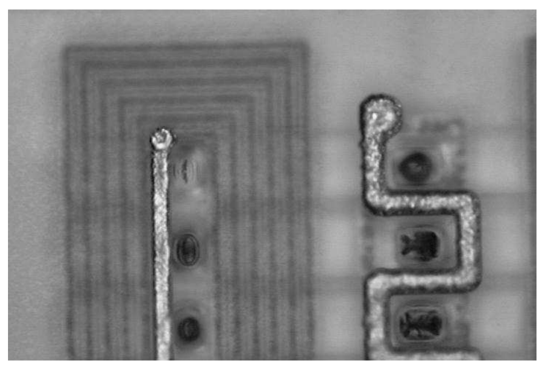

Fig 2: Micrograph of a prototype of a first version completed stator

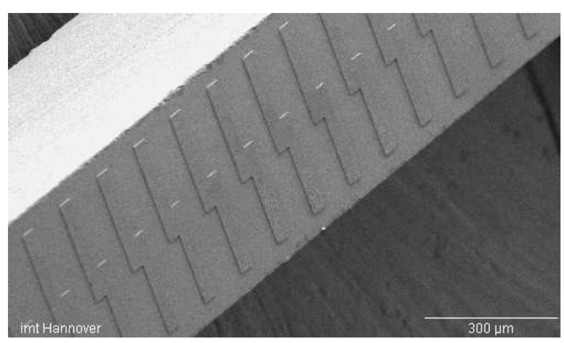

Fig 3: SEM Micrograph of traveler

References

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