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Artificial Electret Material Using EEPROM Technology

Johan Bergqvist* and Jean Marc Moret

Swiss Center for Electronics and Microtechnology Inc.,
CH-2007 Neuchâtel, Switzerland

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An artificial silicon-based electret material has been developed using a microelectronic structure for charge storage. According to the new electret principle, charges are introduced in an insulated conductive layer at a floating potential. The electrical field arising from the charges may be used to bias capacitive sensors and actuators in the same way as with normal dielectric electrets. A device structure using a modified CMOS-EEPROM technology with charge injection by Fowler-Nordheim tunneling, has been theoretically and experimentally analyzed for application as an electret. The results show that the floating conductor voltage may be adjusted by time- or voltage-controlled charge injection, using a MOS field-effect transistor for charge monitoring. Excellent charge retention has been obtained for a polarization of 7 V, both at room temperature and at 100°C. Application to microphones and other aspects of a rechargeable active electret structure are discussed.

1. Introduction

An electret may be defined as a material with a quasi-permanent electrical charge distribution, which is nonvanishing either on a local or on a global level.[1] The locally charged electrets may be obtained through application of a strong electrical field which results in a separation of negative and positive charges into dipoles on a molecular level. The dipole polarization is similar to the magnetic polarization in magnets. The electrets that possess a net global charge usually result from the physical introduction of charges of a particular sign. This type of electret is the most commonly used one, and hereon, we refer only to this kind of electret.

*On leave at Uppsala University, Box 534, S-751 21 Uppsala, Sweden.