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PROCESS FOR PRODUCING COPY PROTECTION FOR AN ELECTRONIC CIRCUIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a process for producing copy protection for an electronic circuit, in particular an integrated circuit, and to an electronic component having copy protection.

2. Description of Related Art

The complexity of electronic circuits, in particular integrated circuits, is becoming more and more complicated on account of ongoing technical development. This brings into play product pirates, who uncover an integrated circuit from the housing in order to analyze it and to abuse the results against the manufacturer's will, and in particular to copy the integrated circuit.

This problem is of particular relevance to electronic circuits for which the manufacturer has a high level of interest in maintaining secrecy, such as for example circuits for decrypting encrypted signals, in particular for pay-TV and plastic chip cards.

Although chips are typically encapsulated in housings or the like, these housings can be removed again by suitable means and therefore do not offer sufficient protection from misuse or copying.

BRIEF SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a process which allows the production of effective and secure copy protection for an electronic circuit.

A further object of the present invention is to provide an electronic component having effective copy protection.

The object of the invention is achieved in a surprisingly simple way just by the subject matter of claims 1 and 25. Further configurations of the invention form the subject matter of the subclaims.

For the process according to the invention for producing copy protection for an electronic circuit, a substrate is provided, the substrate having semiconductor structures on a first side. This substrate is, for example, a silicon wafer with circuits printed on to it which has not yet been divided into chips.

The electronic circuit preferably comprises a switching circuit, an integrated circuit and/or a sensor.

Furthermore, materials for coating the substrate are provided, and the substrate is coated with one or more copy-protect layers. The copy-protect layer or copy-protect layers have the function in particular of protecting against spying on, misuse and copying of individual semiconductor structures and/or the overall circuit. The copy protection in particular protects circuits having semiconductor structures which comprise electronic decryption means, since such circuits are particularly in need of secrecy. One important application area of the invention is therefore protection against product piracy and decryption by unauthorized persons of decoders for pay broadcasting, in particular for pay TV, or for circuits on chip cards which are of relevance to security.

Providing a coating as the copy protection has the advantage of on the one hand providing very effective copy protection or protection against analysis or spying and on the other hand of being simple to apply to the substrate or the wafer.

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Furthermore, a coating offers a uniform protection over the entire coated area, which makes it possible even to prevent spying on parts of the circuit.

In particular, a coating may also be integrated as a substep in the method used to fabricate the circuit. This advantage has a particularly positive effect if coatings, e.g. passivation or stabilization layers, are to be applied in any case. In this case, the copy-protect layer or layers and one or more further coatings, e.g. a passivation or stabilization coating, can be carried out in the same apparatus, in particular a vacuum chamber, preferably without the substrate being removed from the apparatus between the coating operations, so that it is possible to avoid an expensive and time-consuming changeover operation.

It is particularly advantageous in terms of process economics when producing semiconductor products that the copy-protect coating can be applied areally over the as yet undivided wafer, so that a large number of chips can be provided with the copy protection in a single working step. This is advantageous in particular in the case of chips which are encapsulated at wafer level using what is known as wafer level packaging (WLP). In this case, the process according to the invention may on the one hand be used in addition to the WLP or on the other hand may even replace at least substeps of the WLP, in particular if the copy-protect layer or the layer to protect against spying is formed in such a manner that it simultaneously performs a housing and/or stabilization function, i.e. forms an integral part of the housing.

It is preferable for the semiconductor structures, at least in regions, to be covered by means of the copy-protect layer or layers, so that the latter are not accessible without removal of the copy-protect layer or layers.

It is preferable for the copy-protect layer or layers to be matched to the substrate in such a way that an etching process which dissolves the copy-protect layer or layers likewise attacks the substrate, in such a manner that the semiconductor structures are at least partially or fully dissolved, attacked and/or destroyed and/or the logic circuit can no longer be recreated following removal of the copy layer or layers, and consequently an attempt to spy on or copy the circuit in which the copy-protect layer or layers are to be etched away is doomed to failure. Chemical or wet etching, as well as dry or plasma etching, are suitable etching processes for the copy-protect layer or layers.

Therefore, selective removal of the protection layers without damaging the semiconductor structures which are present on the substrate or wafer is therefore impossible or at least much more difficult. Therefore, the structures cannot readily be the subject of unauthorized copying.

It is preferable for at least one copy-protect layer to contain silicon. This is very well matched, in terms of the etching properties, to substrates with semiconductor layers based on silicon.

The copy-protect layer or layers are preferably applied as a layer which is continuous at least in regions and are in particular fixedly, completely and/or areally joined to the substrate and/or bond to the latter, so that attacks other than by etching are also repelled. It is preferable for at least those regions of the substrate in which the semiconductor structures are located to be completely covered and/or hermetically encapsulated by the copy-protect layer or layers.

The inventors have surprisingly discovered that glass is a suitable material for the copy-protect layer. Therefore, in particular a glass layer is applied to the substrate. A silicate glass, e.g. a borosilicate glass, in particular with aluminum