Method for reducing and homogenizing the thickness of a semiconductor layer which lies on the surface of an electrically insulating material

The present invention relates to a method for thinning and planarizing a semiconductor layer by means of an etching treatment with locally varying material erosion.

An example of a technologically relevant semiconductor layer is the functional layer of an SOI wafer (SOI = Semiconductor on Insulator or Silicon on Insulator). As their functional layer, SOI wafers comprise a semiconductor layer, for example a silicon layer, which lies on one surface of a base wafer (or handle wafer). The thickness of the semiconductor layer varies as a function of the components to be processed. Distinction is generally made between so-called thin films (less than 100 nm thick) and so-called thick films (from 100 nm to about 80 μm thick). Either the base wafer may consist entirely of an electrically insulating material (for example glass, quartz, sapphire) or it may for example consist of a semiconductor material, preferably silicon, and merely be separated from the semiconductor layer by an electrically insulating layer. The electrically insulating layer may, for example, consist of silicon oxide.

The semiconductor layer of an SOI wafer must have a very homogeneous thickness as far as the outermost edge region. Particularly in the case of semiconductor layers with a thickness of 100 nm or less, the transistor properties, for example the threshold voltage, vary very greatly in the event of inhomogeneous layer thicknesses. The absolute thickness tolerance for SOI wafers with thin and thick semiconductor layers depends on the layer thickness.

In order to be able to integrate as large a number of circuits as possible, the requisite layer thickness homogeneity must furthermore be ensured as far as the vicinity of the edge of the front side. This in turn means a very small edge exclusion. The term front side of an SOI wafer refers to the side which carries the functional layer, on or in which electronic components are subsequently produced.

All known methods for producing SOI wafers attempt to adjust a sufficient homogeneity of the semiconductor layer directly, although for extreme requirements it may be necessary to carry out a post-treatment of the finished or semiprocessed SOI wafer in order to improve the thickness homogeneity further.

A plurality of methods for the post-treatment of an SOI wafer, with the aim of improving the layer thickness homogeneity, are known in the prior art. Many of these methods involve local etching methods while scanning over the SOI wafer, greater etching erosion being provided at positions with a higher layer thickness: according to US2004/0063329A1, in a dry etching method, the surface of the SOI wafer is scanned with a nozzle through which a gaseous etchant is delivered locally. EP488642A2 and EP511777A1 describe methods in which the semiconductor layer of the SOI wafer is exposed surface-wide to an etchant. This etchant must however be locally activated by a laser beam or a light beam from a light source, which is focused by an optical system, while scanning the surface (photochemical etching).

All methods in which the surface of the semiconductor layer needs to be scanned, in order to achieve locally varying etching erosion, are very time-intensive and therefore cost-

intensive. Furthermore, scanning requires an elaborate movement of the light source or the nozzle, on the one hand, or the SOI wafer on the other hand.

Furthermore, additional inhomogeneities of the layer thickness occur particularly in the edge region of the layer, i.e. in a region up to 5 mm away from the wafer edge, as well as in the regions where the overlap takes place during the scanning. For a layer thickness of 520 nm, a layer thickness homogeneity of 10 nm is achieved according to EP488642A2 without specifying an edge exclusion. According to EP511777A1, for a layer thickness of 108 nm, a layer thickness homogeneity of 8 nm is achieved without specifying an edge exclusion.

DE102004054566A1 describes a method for planarizing a semiconductor layer, in which - after position-dependent measurement of the thickness of the semiconductor layer - the SOI wafer is etched while exposing the entire surface of the wafer. The erosion rate of the etching treatment depends on the light intensity on the surface of the semiconductor wafer, and the light intensity is set position-dependently so that the differences in the previously measured position-dependent layer thickness are reduced by the position-dependent erosion rate. This method corrects local thickness differences of the semiconductor layer very effectively, although it requires additional outlay which increases the costs: a thickness measurement before the etching, the production of a mask for the exposure and an exposure device.

JP09-008258A describes a method in which the silicon layer of an SOI wafer is etched with simultaneous exposure of the entire surface, and its thickness is homogenized. The process is self-regulating, because the etching rate depends on the number of

holes (i.e. defect electrons, that is to say positive charge carriers) which are generated by the light, and therefore on the volume illuminated and consequently on the local silicon layer thickness over the insulating layer. Below a particular residual thickness of the silicon layer, the quantity of charge carriers generated by the light is no longer sufficient and the thinning stops. Since the absorption of light in the silicon layer also depends on the wavelength of the light, this approach furthermore makes it possible to adjust different residual thicknesses of the silicon layer. This method does not therefore require any external position-dependent regulating of the light intensity, or any thickness measurement before the etching, and no mask, although the etching device must still be constructed in such an elaborate way that that light can be shone in.

It is therefore an object of the invention to homogenize the semiconductor layer of an SOI wafer, without requiring elaborate auxiliary equipment such as illumination devices.

The object is achieved by a method for reducing and homogenizing the thickness of a semiconductor layer which lies on the surface of an electrically insulating material, wherein the surface of the semiconductor layer is exposed to the action of an etchant whose redox potential is adjusted as a function of the material and the desired final thickness of the semiconductor layer, so that the material erosion per unit time on the surface of the semiconductor layer due to the etchant becomes less as the thickness of the semiconductor layer decreases and is only from 0 to 10% of the thickness per second when the desired thickness is reached, and wherein the method is carried out without the action of light or the application of an external electrical voltage.

The method according to the invention may be employed for semiconductor wafers made of any materials which are applied on an electrically insulating layer or an electrically insulating base material. This applies, for example, to all SOI wafers. Their functional layer consists of semiconductor material. The semiconductor material preferably contains one or more substances which are selected from the group: silicon, germanium, silicon carbide, III/V compound semiconductors and II/VI compound semiconductors. The method according to the invention may also be employed when the semiconductor layer consists of p-doped silicon. The method may also be used for thinning and homogenizing SOI layers with a thickness of more than 1 μm which, for example have been produced by unilateral grinding or etching after the bonding of donor and base wafers, and which have functional layer thickness variations that are too large for particular applications. The electrically insulating material below the semiconductor layer is generally silicon oxide although other materials such as metal oxides, or nitrides, may also be used.

In the case of an SOI wafer produced by transferring a semiconductor layer from a donor wafer onto a base wafer, the method is carried out after bonding the wafers and separating the layer from the rest of the donor wafer. In the case of an SOI wafer, the method according to the invention may be combined with one or more thermal processes for surface smoothing or for reinforcing the bonding force and/or with one or more oxidation treatments for thinning the semiconductor layer. It is preferable for no polishing to be carried out after the method according to the invention, so as not to deteriorate the planarity again.

The method may also be employed for SOI wafers which have been

produced not by transferring a semiconductor layer but by other technologies, for example SIMOX. The method may also be employed when the semiconductor layer is present not over the entire wafer but only locally. In this case, it may be necessary to protect many regions of the wafer against the etching action.

The method according to the invention is carried out without the action of light. This obviates the need for an etching device adapted to the particular requirements of exposure. In order to carry out the method according to the invention, it is therefore possible to use a conventional etching device, in which a single SOI wafer or a plurality of SOI wafers simultaneously can be treated. Of course, "without action of light" does not mean that the method must be carried out in complete darkness. The action of daylight, or conventional artificial light used for room illumination, has no effect on the success and the economic viability of the method according to the invention, and is of course permissible. The method according to the invention does not however make use of light sources which, by their intensity and wavelength, generate charge carriers in the semiconductor layer that contribute significantly to the etching reaction.

The method according to the invention is carried out without applying an external electrical voltage.

The method is preferably carried out with a liquid etchant. In principle, the etchant may also be added for example as a gel or gas. According to the invention, the redox potential of the etchant is adjusted either so that the material erosion on the surface of the semiconductor layer due to the etchant automatically comes to a stop as soon as the desired final

thickness of the semiconductor layer is reached, or so that the material erosion becomes so slow when the desired final thickness is reached that the etching process can be externally terminated after a certain time (for example by removing the wafer from the etchant), without thereby exceeding or falling below the desired final thickness in a way which is significant for practical purposes. The maximum "error" when externally terminating the etching reaction should not amount to more than 10% of the desired final thickness. Since the time taken for manually stopping the etching reaction is at most one second (for example in order to remove the wafer from the etchant), in the context of the invention it is sufficient for the etching erosion when reaching the desired final thickness of the semiconductor layer to be so small that it only amounts to between 0 and 10% of the thickness of the semiconductor layer per second. Expressed in absolute numbers, the etching rate when reaching the desired final thickness of the semiconductor layer should preferably be between 0 and 1 nm per second.

As will be described below, a suitable redox potential may be achieved by a suitable choice of the composition of the etchant. In particular, the constituents of the etchant or their concentrations, or both, may be selected suitably. In most cases, the redox potential of the etchant will be determined essentially by its pH. In these cases, the concentrations of the constituents of the etchant will be selected so that a suitable pH is adjusted.

It is possible to select the pH of the etchant at the start of the etching treatment according to the invention so that a comparatively high etching rate is obtained. In the course of the etching treatment, the pH of the etchant and therefore its redox potential may subsequently be modified, preferably by

adding (i.e. increasing the concentration of) one of its constituents, so that the etching rate lies in the range according to the invention when the desired final layer thickness is reached. Preferably, however, the pH is not modified during the etching treatment, i.e. preferably no substances are added while the etching treatment is being carried out.

The redox potential furthermore depends on the temperature. According to Nernst's equation, the redox potential is proportional to the temperature. The desired final thickness may additionally be influenced in this way.

If the semiconductor layer contains silicon or even essentially consists of silicon (which may of course be doped), then the etchant preferably contains one or more fluorine compounds. In particular, an etchant which contains hydrogen fluoride (HF) and a fluoride salt is preferred in this case. For practical reasons it is preferable to use water as a solvent, although water is not a mandatory constituent. The fluoride salt is preferably ammonium fluoride (NH_4F). Other salts are also possible in principle, although NH_4F has the advantage that it is used in the semiconductor industry and is therefore available with the necessary specifications, that it makes it possible to adjust the pH when mixed with HF, and that it acts as a pH buffer when mixed with HF.

For different semiconductor layers, other etching solutions are necessary. For instance, germanium can be etched for example with hydrochloric acid (HCl/H_2O) or with an aqueous solution of hydrogen chloride and hydrogen peroxide ($HCl/H_2O_2/H_2O$), gallium arsenide (GaAs) can be etched for example with an aqueous solution of phosphoric acid and hydrogen peroxide

($H_3PO_2/H_2O_2/H_2O$) or with an aqueous solution of nitric acid and sulfuric acid ($HNO_3/H_2SO_4/H_2O$) indium phosphide (InP) can be etched for example with a mixture of hydrogen chloride and phosphoric acid (HCl/H_3PO_2) or with an aqueous solution of hydrogen chloride and nitric acid ($HCl/HNO_3/H_2O$).

The method according to the invention will be described in detail below with reference to use on SOI wafers with silicon functional layers and etchants based on HF or NH_4F or mixtures thereof, although it may also be applied to other layer structures, other semiconductor materials and other etchants.

Brief Description of the Figures

Fig. 1: band bending in p-doped silicon upon contact with hydrofluoric acid (hydrogen fluoride, HF, in aqueous solution).

Fig. 2: band bending in n-doped silicon upon contact with hydrofluoric acid (hydrogen fluoride, HF, in aqueous solution).

Fig. 3: profile of the space charge zone in bulk silicon material.

Fig. 4: profile of the space charge zone in the functional layer, consisting of silicon, of an SOI wafer.

Fig. 5: sketched profile of the band bending inside a silicon wafer upon contact with an aqueous HF solution.

Fig. 6: sketched profile of the band bending inside a silicon wafer upon contact with an aqueous ammonium fluoride solution (NH_4F).

Fig. 7: dependency of the etching depth d (in nm) in the 100 nm thick silicon layer of an SOI wafer on the pH of the aqueous etching solution used, comprising a mixture of 5% strength HF and 5% strength NH_4F, at a temperature of 25°C after an etching time of t = 5 min. The curve represents an exponential fit of the dependency.

Fig. 8: profile of the etching depth d (in nm) with the reaction time t (in min) for an aqueous solution comprising a mixture of 10% strength HF and 10% strength NH_4F solutions on the 100 nm thick silicon layer of an SOI wafer. The pH was adjusted to a value of 5.5. The temperature was kept at 25°C. The straight line represents a linear extrapolation of the measurement values up to t = 60 min.

Fig. 9: profile of the etching depth d (in nm) with the reaction time t (in min) for a 2200 nm thick silicon layer of an SOI wafer for aqueous etching solutions comprising mixtures of 5% strength HF and 5% strength NH_4F solutions and with different pH values at a temperature of 10°C.

Fig. 10: profile of the etching depth d (in nm) with the reaction time t (in min) in a 100 nm thick silicon layer of an SOI wafer for an aqueous etching solution comprising a mixture of 5% strength HF and 5% strength NH_4F solutions with a pH of 4 and a temperature of 10°C.

Preferred Embodiments

Silicon (Si) is an indirect semiconductor with a bandgap of 1.12 eV. The behavior in contact with an electrolyte can therefore be explained very clearly by the band model. If silicon is brought in contact with aqueous hydrofluoric acid

(HF), for example, then equalization of the electrochemical potentials takes place at the interface between the silicon and the electrolyte. In order to prevent the emergence of freely mobile charge carriers from the silicon, a space charge zone is formed at the interface. An excess charge Q in the form of static charges is then formed in the space charge zone, i.e. there are no longer any freely mobile charge carriers there. This is countered on the electrolyte side of the interface by an opposite charge -Q in the form of an electrolytic double layer. Unless a solution is extremely dilute, it will contain a charge carrier concentration which exceeds that in silicon (depending on the doping level) by an order of magnitude. The charge on the electrolyte side can therefore be compensated for by a very thin layer in the range of a few nanometers.

On the other hand, for moderate to low dopings, the space charge zone in silicon extends over a depth of the order of one micrometer. The entire electrical potential, which is due to the charge Q in the silicon space charge zone and the electrolytic double layer, therefore falls off within the silicon. This potential drop in the space charge zone of the silicon entails band bending inside the silicon, at the interface between the silicon and the electrolyte (Figs 1, 2).

For p-doped silicon (Fig. 1), the valence and conduction bands (1 and 2 respectively) at the Si/HF interface are curved toward lower electron energies (downward). The silicon surface is therefore depleted of holes. For n-doped silicon (Fig. 2), on the other hand, the bands are curved toward higher electron energies (upward). The silicon surface is depleted of conduction band electrons. The symbols 3 and 4 respectively stand for the ionized dopant atoms.

The contact of HF with p-doped silicon having a resistivity of from 0.5 to 1 Ωcm leads to a space charge zone width of about 1 micrometer. Although the surface is depleted of holes, it could nevertheless still be etched by the HF solution. The required holes come from the bulk of the silicon, where they are thermally regenerated.

In general, two ways of dissolving silicon are available. On the one hand silicon may be attacked and dissolved directly, and on the other hand, the route of forming and dissolving silicon dioxide (SiO_2) may be adopted. In acidic solutions containing hydrofluoric acid, the direct route leads only to very low etching rates of a few tenths of a nm/min.

$$Si + 2\ HF_2^- + 2\ HF \leftrightarrows [SiF_6]^{2-} + 2\ H_2 \qquad (1)$$

A two-stage process is therefore recommendable for etching with hydrofluoric acid. In a first step silicon is oxidized to form silicon dioxide, and the latter is subsequently dissolved by the hydrofluoric acid.

$$Si + 6\ H_2O + 4\ h^+ \leftrightarrows SiO_2 + 4\ H_3O^+ \qquad (2)$$

$$SiO_2 + 4\ HF \leftrightarrows SiF_4 + 2\ H_2O \qquad (3)$$

$$SiF_4 + 2\ HF + 2\ H_2O \leftrightarrows [SiF_6]^{2-} + 2\ H_3O^+ \qquad (4)$$

The rates of this reaction path are a factor of 1000 to 10000 higher than for direct dissolving of silicon according to Reaction Equation (1). Despite the simultaneous existence of both reaction paths, therefore, the direct dissolving may be neglected.

In principle all these considerations may be applied directly to the silicon layer of an SOI wafer, since an HF/Si interface

is still involved. However, the behavior is not comparable to that of the bulk material. The crucial difference between bulk material and SOI material resides in the thickness of the functional layer.

The band model per se is naturally retained even for a thin layer. However, the ratio of the space charge zone width to the thickness of the silicon layer changes. While the space charge zone in bulk material can extend over the entire thickness of the silicon wafer (Fig. 3), in the case of an SOI wafer it is limited to the thickness of the functional layer (Fig. 4). For the described resistivity range, the space charge zone in bulk material is at least an order of magnitude larger than the thickness of the functional layer of an SOI wafer.

Since only the charge carriers inside the functional layer need to be considered in the case of SOI, the band bending and the space charge zone width are also correspondingly less. The redox potential at the interface between the etchant and the silicon is therefore shifted, which has a corresponding effect on the reactions that are possible.

The model assumptions concerning the process of dissolving silicon by means of hydrofluoric acid are fully retained even for thin silicon layers. The dissolving of silicon on the surface of the functional layer also takes place via one of the two mechanisms, i.e. direct or indirect dissolving. The holes required for this (h^+, "defect electrons") are provided from the functional layer. This can now take place only from a very limited reservoir, however, since their number varies proportionally to the volume of silicon present. If the reaction at the interface takes away more holes from the silicon than can be thermally regenerated, then the absolute

number of holes in the functional layer decreases until any hole that is generated is immediately accelerated to the interface. For a rapid reaction, this means that the space charge zone would extend over the entire thickness of the functional layer. If the reaction takes place more slowly, then the space charge zone width can also be smaller so that some of the functional layer continues to have free mobile charge carriers.

The width of the space charge zone inside the functional layer is crucial for the properties of the functional layer. In the normal case, the band bending leads to depletion of holes or electrons at the interface. Owing to the subsequent flat band potential, not all the charge carriers can follow the potential profile. But if the band bending spreads through the entire volume, then the potential will fall off across it. Full drainage of charge carriers is therefore possible. This situation occurs for example when etching an SOI wafer with a 100 nm thick semiconductor layer by an etching solution made up of 48% strength HF with H_2O_2 with pH 1 at room temperature: the semiconductor layer is preserved during an etching time of one hour, i.e. the final thickness of the semiconductor layer is more than 100 nm when using said etching solution. Under these conditions, several μm would be etched on bulk material.

The classical combination of hydrofluoric acid (HF) and nitric acid (HNO_3) likewise does not dissolve the silicon layer at room temperature. Only increasing the temperature to about 50°C leads to the desired result within seconds. Combinations with weaker oxidants such as phosphoric acid (H_3PO_4) or hydrogen peroxide (H_2O_2) do not etch the silicon layer at room temperature, and do so only very slowly at higher temperatures. Conversely with strong oxidants, for example chromic acid, full

erosion of the silicon layer is possible within an extremely short time.

For partial etching of the functional layer, therefore, suitable etchants are needed. Suitable etchants must generate a band shift in the functional layer, such that the flat band potential in the functional layer is preserved.

For the SOI wafers in question, ammonium fluoride (NH_4F) is a suitable etchant. In respect of bulk material, it is known that an NH_4F solution etches much more slowly than an HF solution. For the thin silicon layer of an SOI wafer, this relationship is reversed: for a 100 nm thick SOI layer, initial etching rates of a few nm/min can be achieved at room temperature.

The difference between an ammonium fluoride solution and a hydrogen fluoride solution - besides the different cations - resides in the pH of the solution. An HF solution has a pH of about 1 and an NH_4F solution has a pH of about 7. The different pH value leads to a shift in the chemical potential of the NH_4F solution in relation to the HF solution. From the literature, it is known that the band bending in silicon also varies linearly with the pH. The chemical potential of the NH_4F solution matches the potential of the band bending of the silicon of the functional layer better than the potential of an HF solution does. At the same time, the reaction takes place more slowly and only a few holes are needed per unit time, which leads to a smaller space charge zone width in the functional layer. The flat band potential is maintained in the functional layer (Fig. 6). The etching of the functional layer therefore takes place similarly as that of the bulk material. In comparison with the etching of bulk material by an HF solution, however, it occurs much more rapidly.

Adjusting the pH provides the opportunity to optimize the effect of the etchant further. For example, the pH and therefore the etching rate may be varied by mixing HF and NH_4F solutions. The effect of the pH on the etching rate was studied with the aid of a series of mixtures made from a 5% strength HF solution and a 5% strength NH_4F solution. From these solutions, all pH values between 1 and 7 can be adjusted by means of different mixing ratios without thereby affecting the concentration of fluoride ions. SOI wafers having a silicon layer with an initial thickness of 100 nm were etched in the etching solutions thus produced, respectively with a different pH, for a defined time (5 minutes). The temperature was kept at 25°C. Fig. 7 reveals an exponential rise in the etching depth d (in nm) with an increasing pH, which corresponds to an exponential rise in the etching rate with the pH. For pH=7 a maximum of 12 nm/min is reached, although this may also be increased further by changes in concentration and temperature. The response to a pH shift is therefore the reverse of the response in the case of bulk material. The redox potential at the interface is shifted in favor of a reaction with ammonium fluoride. An HF-NH_4F solution is therefore capable of eroding the functional layer at room temperature with an adjustable etching rate of from 1 to 12 nm/min.

When the functional layer becomes thinner and thinner with continued etching, the same effect as was found for hydrofluoric acid finally comes into play: the number of charge carriers remaining in the thin functional layer become smaller and smaller, so that the band bending also becomes progressively weaker. Associated with this, there is a shift in the redox potential at the interface. Owing to this shift, the etching rate decreases until reaction with the ammonium

fluoride solution is no longer possible.

Studying the etching depth on SOI wafers as a function of the reaction time confirms this hypothesis. Fig. 8 represents the etching depth d (in nm) after various etching times for the 100 nm thick silicon layer of an SOI wafer. The etching solution consists of a mixture of 10% strength aqueous HF and 10% strength aqueous NH_4F with a pH of 5.5. The etching temperature was kept at 25°C. A clear linear dependency of the etching depth on the reaction time can be seen, until a depth of approximately 75 nm is exceeded after an etching time of about 60 min. If the initial etching rate were to be extrapolated, then the entire 100 nm thick semiconductor layer should be etched away after an etching time of 80 min. However, a thin silicon layer remains even with an etching time of 100 min, which can be seen from the fact that the oxide is not attacked.

Fig. 9 describes the development of the etching depths d (in nm) as a function of the etching time t (in min) for SOI wafers with a 2200 nm thick semiconductor layer, which were etched with the aid of etching solutions having different pH values. The pH values of the etching solutions were respectively established by mixing 5% strength aqueous HF and 5% strength aqueous NH_4F solutions in suitable ratios. The temperature was kept at 10°C. It can be seen that the etching action decreases as the etching time increases, i.e. the etching rate decreases as the thickness of the semiconductor layer decreases. The etching depths tend toward different limit values as the etching time increases, i.e. different final thicknesses of the silicon layer can be achieved with a different pH of the etching solution.

This property of ammonium fluoride solutions may be employed as

an etch stop for SOI wafers, in so far as the functional layer becoming thinner prevents itself from being penetrated. The depth of the etch stop action may be regulated by adjusting the pH.

Fig. 10 shows the way in which an SOI wafer with an initially 100 nm thick semiconductor layer can be thinned in a controlled way. An aqueous etching solution, in which a pH of 4 was adjusted by mixing 5% strength aqueous HF and 5% strength aqueous NH_4F in a suitable ratio, etches at most about 25 nm at a temperature of 10°C (etching depth $d \approx 25$ nm with prolonged etching time t), i.e. the thickness of the semiconductor layer can be reduced in a controlled way to 75 nm. This thickness may be controlled by changing the pH. With a pH of 5, for example, the semiconductor layer is reduced to a final thickness of about 50 nm.

Patent claims

1. A method for reducing and homogenizing the thickness of a semiconductor layer which lies on the surface of an electrically insulating material, wherein the surface of the semiconductor layer is exposed to the action of an etchant whose redox potential is adjusted as a function of the material and the desired final thickness of the semiconductor layer, so that the material erosion per unit time on the surface of the semiconductor layer due to the etchant becomes less as the thickness of the semiconductor layer decreases and is only from 0 to 10% of the thickness per second when the desired thickness is reached, and wherein the method is carried out without the action of light or the application of an external electrical voltage.

2. The method as claimed in claim 1, wherein the semiconductor layer contains one or more substances which are selected from the group: silicon, germanium, silicon carbide, III/V compound semiconductors and II/VI compound semiconductors.

3. The method as claimed in claim 1 or 2, wherein the redox potential of the etchant is adjusted via the composition of the etchant.

4. The method as claimed in claim 3, wherein the redox potential of the etchant is adjusted via the choice of the constituents of the etchant.

5. The method as claimed in claim 3, wherein the redox potential of the etchant is adjusted via the concentrations of the constituents of the etchant.

6. The method as claimed in claim 5, wherein the redox potential of the etchant is determined by its pH, and wherein the concentrations of the constituents of the etchant are selected to adjust the pH of the etchant.

7. The method as claimed in claim 3, wherein the redox potential is additionally adjusted via the choice of the temperature.

8. The method as claimed in claim 3, wherein the semiconductor layer contains silicon and the etchant contains one or more fluorine compounds.

9. The method as claimed in claim 8, wherein the etchant contains hydrogen fluoride and a fluoride salt.

10. The method as claimed in claim 9, wherein the fluoride salt is ammonium fluoride.

11. The method as claimed in claim 1 or 2, wherein the semiconductor layer consists of p-doped silicon.

12. The method as claimed in claim 1 or 2, wherein the semiconductor layer is the functional layer of an SOI wafer.

13. The method as claimed in claim 1 or 2, wherein material erosion per unit time on the surface of the semiconductor layer due to the etchant is from 0 to 1 nm when the desired final thickness is reached.