Chromium Etching

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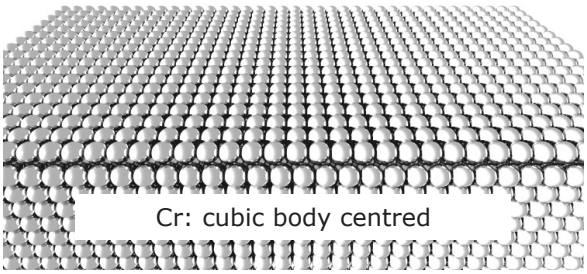
www.microchemicals.com/downloads/application_notes.html

Concentrations

All chemicals concentrations mentioned in this chapter with a * refer to a conventional concentration listed in the last section of this document.

Chromium

Chromium is a hard metal with good adhesion to many materials. Therefore, in the field of microstructuring chromium is used for photo masks and as adhesion promotor for subsequently coated materials.



Chromium Etching Mechanism

Chromium etchants typically are mixtures of perchloric acid ($HClO_4$), and ceric ammonium nitrate $(NH_4)_2[Ce(NO_3)_6]$.

Perchloric acid is a very strong acid and therefore almost completely dissociated in aqueous solutions (pK_S < -8), and serves for chemically stabilizing the ceric ammonium nitrate. Ceric ammonium nitrate itself is a very strong oxidizer.

The following chemical equation summarizes the mechanism of chromium etching with perchloric acid and ceric ammonium nitrate:

$$3\ Ce(NH_4)_2(NO_3)_6 + Cr \rightarrow 3\ Cr(NO_3)_3 + 3\ Ce(NH_4)_2(NO_3)_5\ ,$$

Hereby the cerium oxidation state is reduced from IV to III, whereas the chromium oxidation state increases from II to III.

Chromium nitrate steadily produced during etching forms a dark film on the chromium surface and - due to its aqueous solubility - is dissolved in the etchant.

Selectivity

Copper, silver and vanadium are strongly etched by this etchant, while aluminium, titanium, tungsten and nickel show a comparable low etch rate.

The noble metals gold, platinum and palladium are not attacked.

Our Chromium Etch

Our chromium etch "Chrome etch n° 1" has the composition:

Ceric ammonium nitrate : perchloric acid : H_2O = 10.9 % : 4.25 % : 84.85 %

and reveals an etch rate of approx. 60 nm/minute at room temperature.

We supply this mixture in 2.5 L sales volumes in MR quality. Other grades/sales volumes available on request.

Suited Photoresists and their Processing for Cr Etching

All AZ® and TI resists are suited and sufficiently stable as mask for etching few 100 nm of Chromium. Generally, we recommend the usage of resists with optimized adhesion such as the AZ® 1500 series (resist film thickness range approx. 0.5-3 µm via the AZ® 1505, 1512 HS, 1514 H, and 1518), or the AZ® 4533 (3-5 µm).

The deeper Cr has to be etched, the ticker the resist film should be. If this requires a high aspect ratio, we recommend the high-resolution AZ® ECI 3000 series (resist film thickness range approx. 0.5-4 µm).

In order to improve the resist adhesion, a hardbake after development can be beneficial. We recommend 140-145°C for 5-10 minutes. Since the resist film hereby embrittles, the cooling down to room temperature should not take place abruptly in order to prevent the formation of cracks.

All common NaOH-, KOH-, or TMAH-based developers and all typical removers are compatible with Chromium.

All resists and ancillaries mentioned in this section are distributed by us and more detailed in the document Photoresists, Developers, and Removers.

Dilution Grade of the Substances Mentioned in this Document

HCl* = 37% HCl in H_2O	HNO_3* = 70% HNO_3 in H_2O
H_2SO_4* = 98% H_2SO_4 in H_2O	HF* = 49% HF in H_2O
H_2O_2* = 30% H_2O_2 in H_2O	H_3PO_4* = 85% H_3PO_4 in H_2O
NH_4OH* = 29% NH_3 in H_2O	CH_3COOH* = 99% CH_3COOH in H_2O

Disclaimer of Warranty

All information, process guides, recipes etc. given in this brochure have been added to the best of our knowledge. However, we cannot issue any guarantee concerning the accuracy of the information.

We assume no liability for any hazard for staff and equipment which might stem from the information given in this brochure.

Generally speaking, it is in the responsibility of every staff member to inform herself/himself about the processes to be performed in the appropriate (technical) literature, in order to minimize any risk to man or machine.