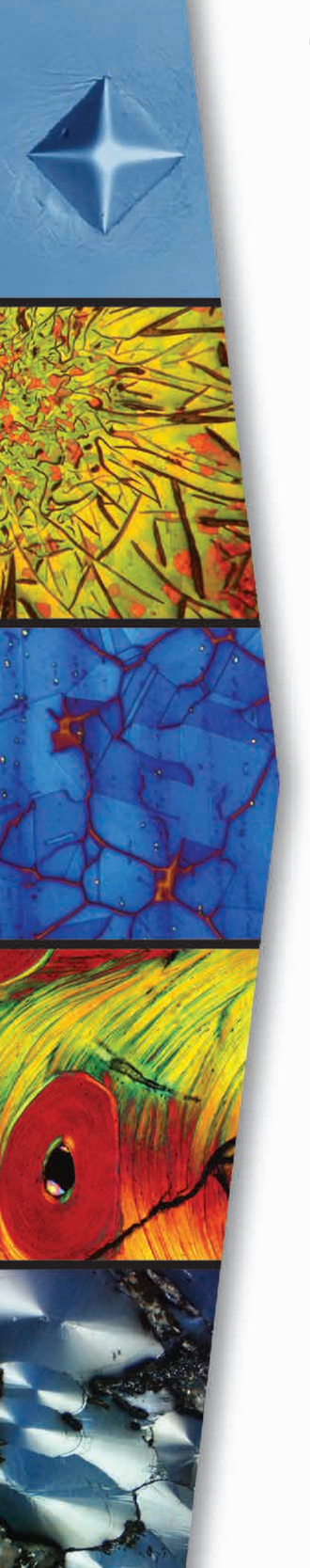

Technical Information Guide:

Etchants for Iron and Steel

Nital 1-10 mℓ HNO_3 90-99 mℓ Ethanol or Methanol	Most common etchant for Fe, Carbon and Alloy steels, Cast irons. Reveals alpha grain boundaries and constituents. The 2% solution is the most common. Use by immersion for up to 60 seconds or by swabbing. Do not store ethanolic solutions that exceed 2% nitric acid. The 5-10% solution is used for high-alloy steels should not be stored if made with ethanol. (Boylson)
Picral 4g Picric Acid 100 mℓ Ethanol	Recommended for structures consisting of ferrite and carbide. Does not reveal ferrite grain boundaries. Addition of 0.5-1% zephiran chloride (a commonly used antibacterial agent) improves etch rate and uniformity. Use by immersion for up to 60 seconds or by swabbing. (Igevski)
Glyceregia 3 parts HCl 2 parts Gylcerol 1 part HNO_3	For high-alloy steels, austenitic Mn steels, stainless steels and Ni-base alloys. Reveals grain structure, outlines sigma and carbides. Use fresh. Discard when turns yellow/orange. Do not store. For slower action and for martensitic or ferritic stainless steel, use 2 parts HCl. Swab sample 5-30 seconds.
Vilella's Reagent 1g Picric Acid 5 mℓ HCl 100 mℓ Ethanol	For high alloy steels and stainless steels. Use at 20°C for up to 1 minute by immersion or swabbing. Outlines constituents such as carbides, sigma phase and delta ferrite; etches martensite.

Etchants for Copper and Alloys

25 mℓ NH_4OH 25 mℓ Distilled Water (optional) 25-50 mℓ H_2O_2 (3%)	General-purpose grain-contrast etch for Cu and alloys (does not always produce grain contrast). Use fresh, add peroxide last. Use under a fume hood. Swab sample 5-45 seconds.
5g $Fe(NO_3)_3$ 25 mℓ HCl 70 mℓ Distilled Water	Excellent general-purpose etch, reveals grain boundaries well. Immerse sample 10-30 seconds. (Slepian and Prohaska)

Etchants for Aluminum and Alloys

0.1-10 mℓ HF 90-100 mℓ Distilled Water	General-purpose reagent. Attacks $FeAl_3$, other constituents outlined. Grain contrast usually poor. The 0.5% concentration of HF is very popular. Use by swabbing.
Keller's Reagent 2.5 mℓ HNO_3 1.5 mℓ HCl 1 mℓ HF 95 mℓ Distilled Water	Very popular general-purpose reagent for Al and Al alloys, except high Si alloys. Swab sample 10-20 seconds. Wash in warm water. Can follow with a dip in concentrated HNO_3. Outlines all common constituents, reveals grain boundaries in certain alloys.

Etchants for Nickel and Alloys

Kalling's No. 2 2g $Cu\ Cl_2$ 40 mℓ HCl 40-80 mℓ Ethanol	"Waterless Kalling's" for Ni-Cu, superalloys and stainless steels. Good for grain size. Swab for up to a few minutes. Can be stored.
Acetic Glyceregia 15 mℓ HCl 10 mℓ Acetic Acid 5 mℓ HNO_3 1-2 drops Glycerol (optional)	For superalloys. Use fresh. Discard when turns yellow/orange. Do not store. Swab sample 5-30 seconds.

Etchants for Titanium and Alloys

Kroll's Reagent 2-6 mℓ HNO_3 100 mℓ Distilled Water	Very good etch. Swab 3-10 seconds or immerse sample 10-30 seconds.

Safe laboratory practices should be followed, consult MSDS of all chemicals used in etch solutions prior to use. Safety is the responsibility of the user; Buehler disclaims all liability with respect to use of these chemicals and etch solutions.

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