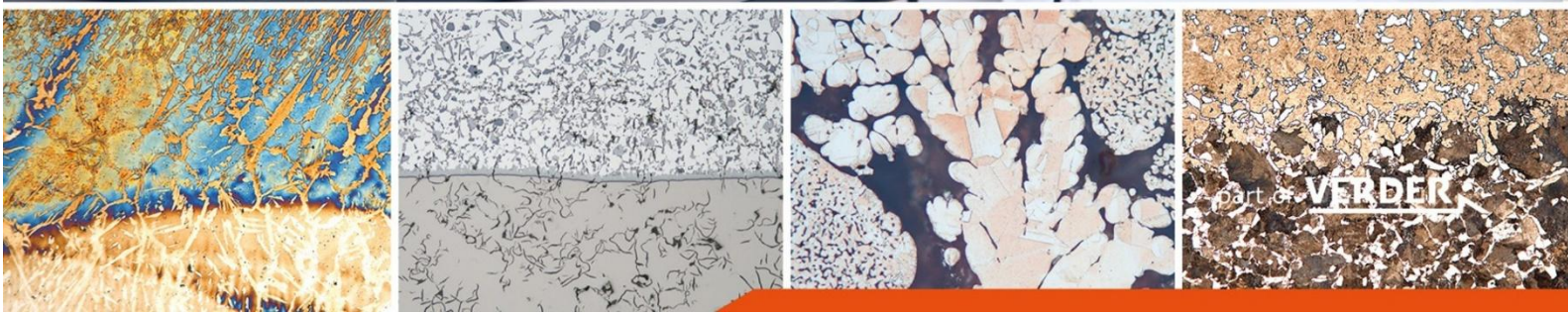


# Application lab. report

## Steel screws

### Preparation to analyze the microstructure and hardened zone



## QATM-Preparation method

### Objective:

The steel screws should be metallographically prepared to analyze the microstructure and the hardened zone.


The samples were cut on the machine QCUT 250 A, hot mounted with our Qpress 40, grounded and polished with the machine QPOL 300 A1. They were then etched with alcoholic nitric acid and with Beraha 2.



Figure 1. As-received samples

## QATM-Preparation method

### Cutting

 <b>Cutting</b>			
Device	Cut-off disc	Anti-corrosion coolant	Clamping tool
Qcut 250 A	<ul style="list-style-type: none"> <li>- FS-C ø250mm</li> <li>- Corundum precision cut-off disc ø20mm</li> </ul>	QATM standard	<ul style="list-style-type: none"> <li>- Qtool 80 Vario</li> <li>- Qtool 40</li> </ul>
<b>Cutting method</b>			
Horizontal cutting (X-Axis)			
<b>Parameters</b>			
Feed speed	Pulse parameter	Cut-off disc rotational speed	
0,2 mm/s - 0,3 mm/s	/	fixed	
<b>Notes</b>			

## QATM-Preparation method

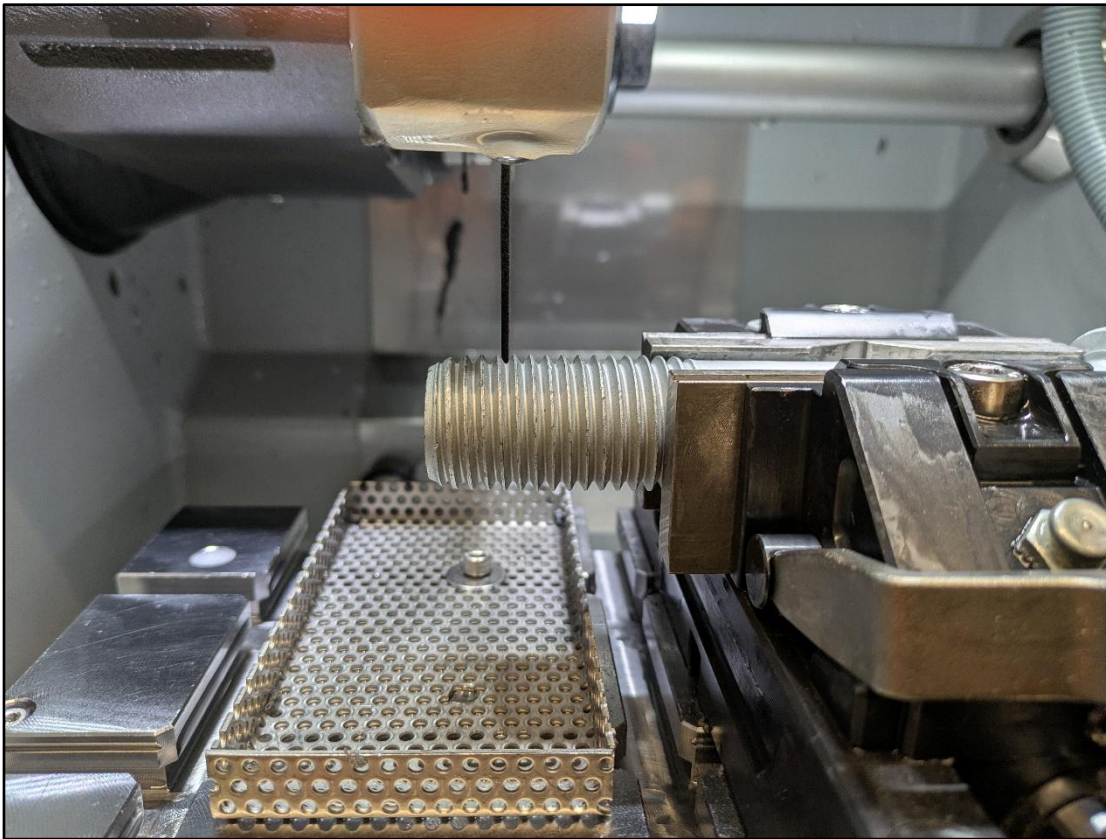


Figure 2. Clamping sample in Qtool 80 Vario

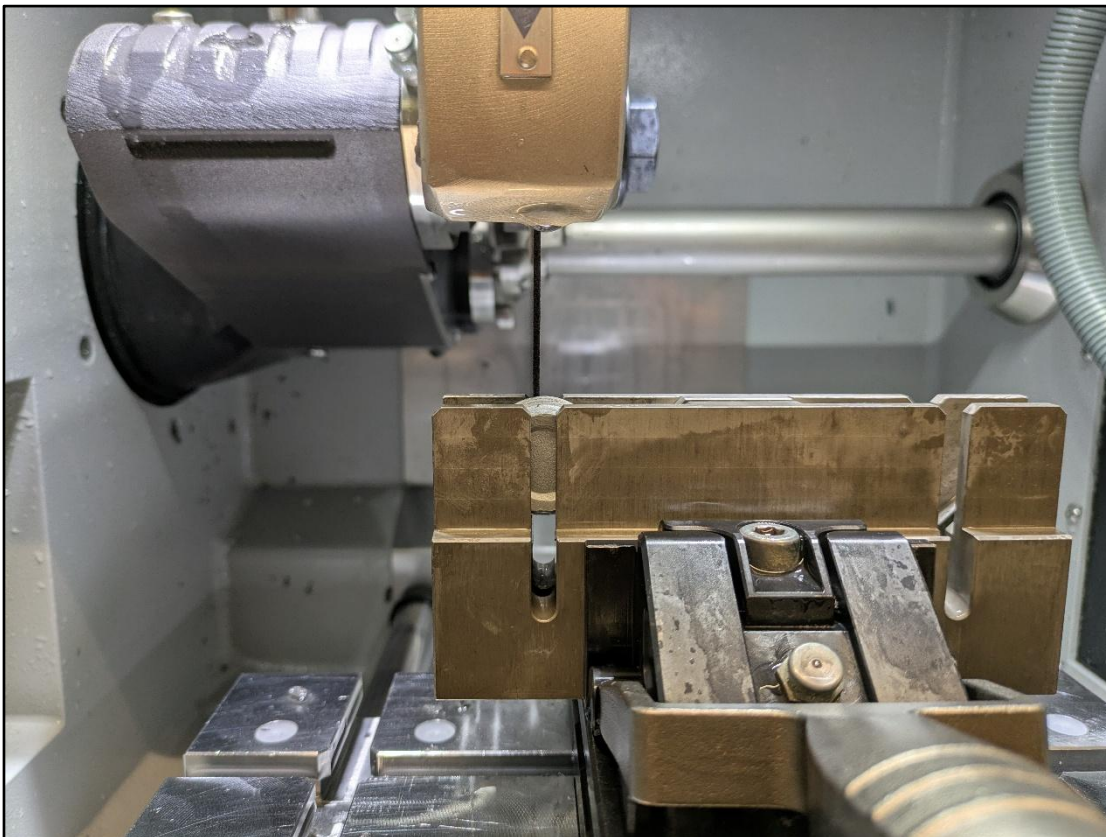


Figure 3. Clamping sample in the clamping jaw with slotted for round bar

## QATM-Preparation method

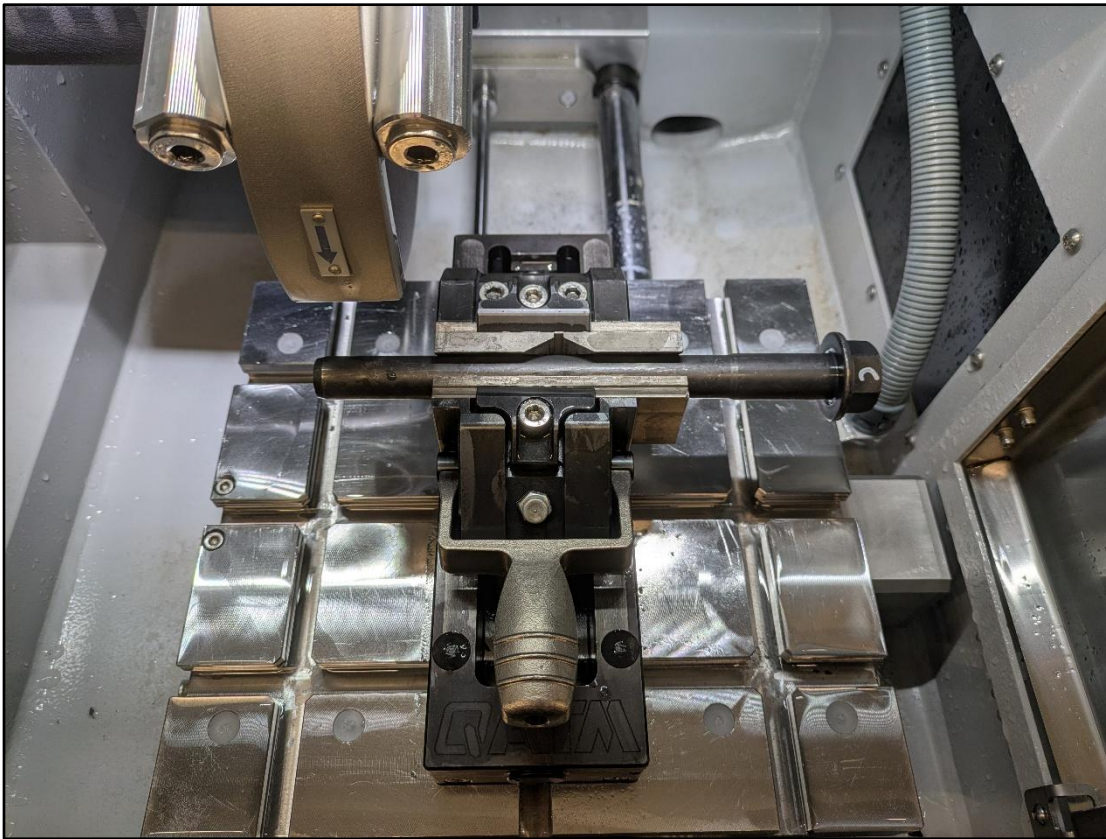


Figure 4. Clamping sample (top view)

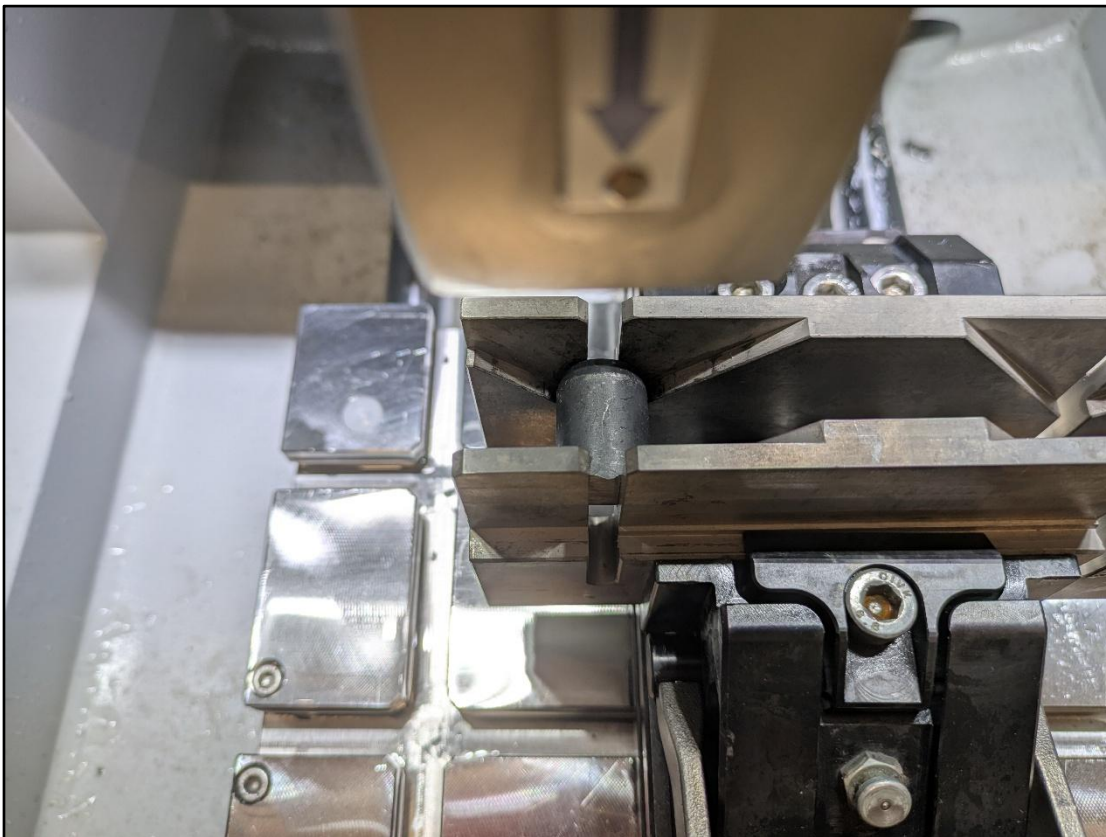


Figure 5. Clamping sample for cutting in half (top-view)

## QATM-Preparation method

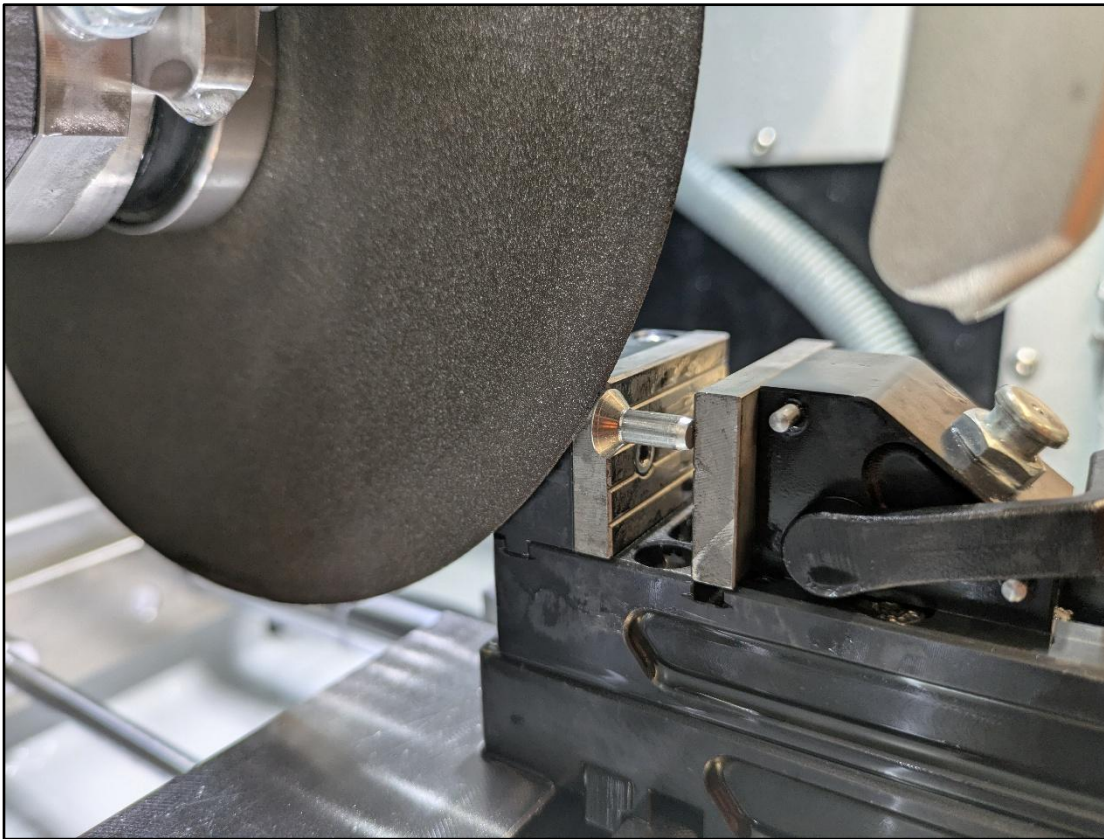



Figure 6. Clamping sample in Qtool 40 (side-view)



Figure 7. Overview sample after cutting

## QATM-Preparation method

### Hot mounting

 <b>Mounting</b>					
Device	Consumable	Heating time	Temperature	Pressure	Cooling time
Qpress 40	Epo black	03:15 min	200°C	250 bar	02:45 min
Filler or additional consumables	Heating power	Pressure mode	Cooling power		
/	100%	1-step	100%		
Notes					
-					

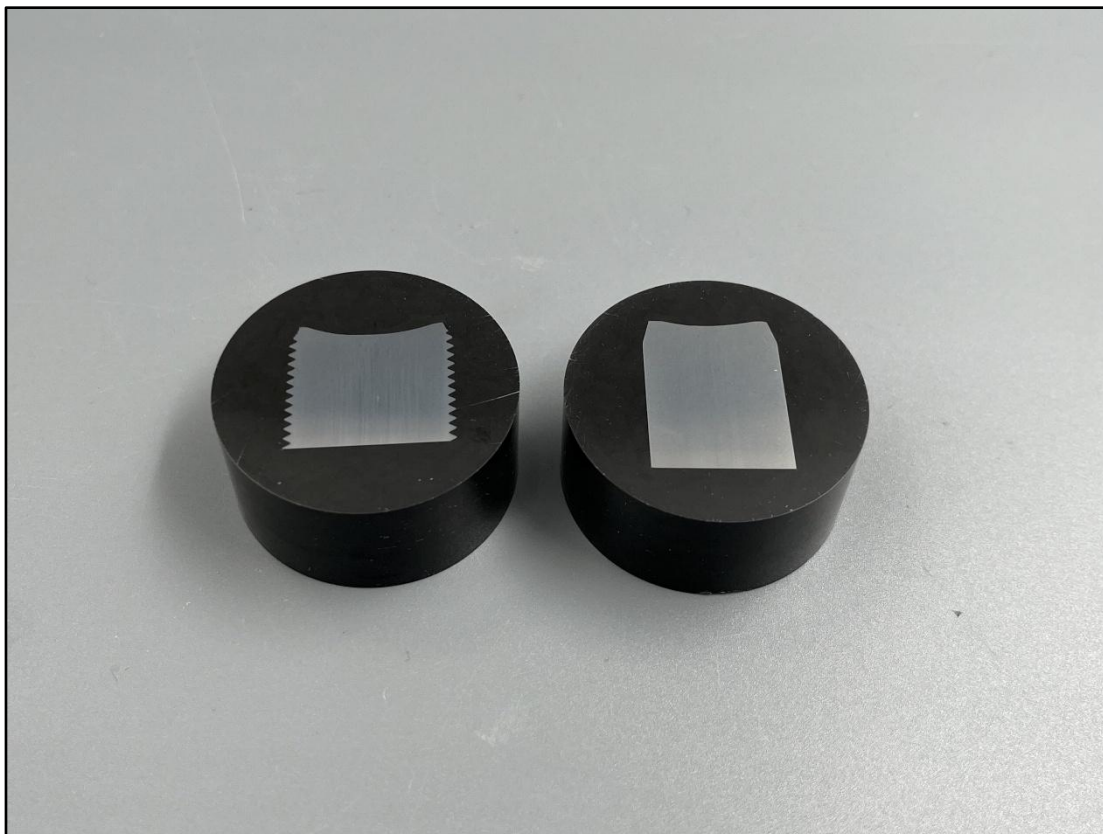











Figure 8. Sample after hot mounting

## QATM-Preparation method

### Grinding/Polishing

Device	Sample holder	Pressure mode					
QPOL 300 A1 Eco +	Sample holder L 6 x ø40mm	Single					
Step	MEDIUM		 RPM	 N	 min		
 Planar grinding	Vega 54µm	H <sub>2</sub> O	200	100 ◀ ▶	30	Till flat	
 Fine grinding	Contero H	Dia Complete Poly, 9µm	150	100 ◀ ▶	30	5:00	
 Polishing	GAMMA	Dia Complete Poly, 3µm	150	100 ▶ ▶	30	6:00	
 Polishing	ZETA	Dia Complete Poly, 1µm	150	120 ▶ ▶	25	1.00	
 Etching (chem.)	Alcoholic Nitric Acid (3%)					0:05-0:10	

#### Notes

- Pre-dosing for 9 µm, 3 µm und 1 µm: 3 s  
Dosing interval and dosing duration for 9 µm, 3µm, 1µm:  
Every 35 s for 1,3 s

## QATM-Preparation method

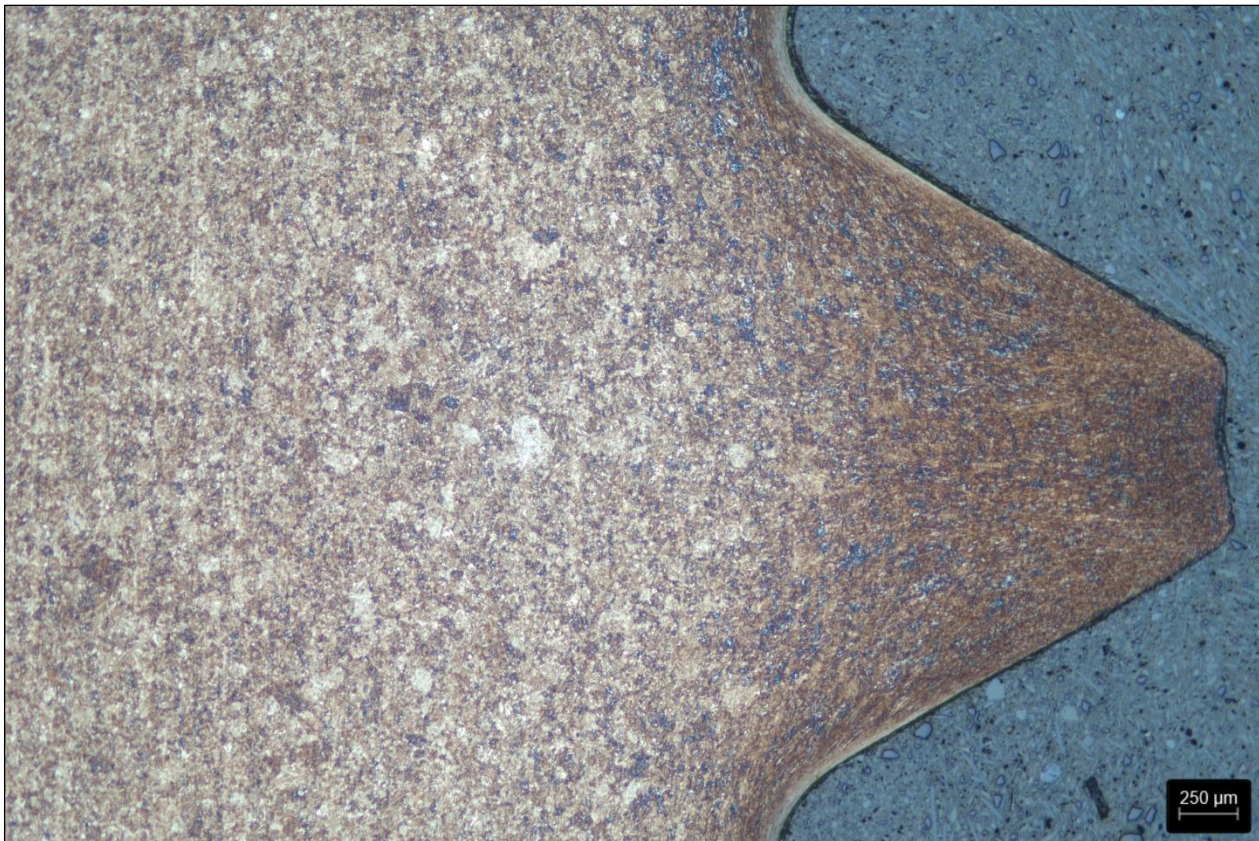


Figure 9. Overview of the thread profile of sample - 25:1



Figure 10. Microstructure in the center of Sample - 100:1

## QATM-Preparation method



Figure 11. Overview of the thread profile - 25:1



Figure 12. Microstructure in the center of Sample - 100:1

## QATM-Preparation method



Figure 13. Crest of the thread profile of sample - 100:1

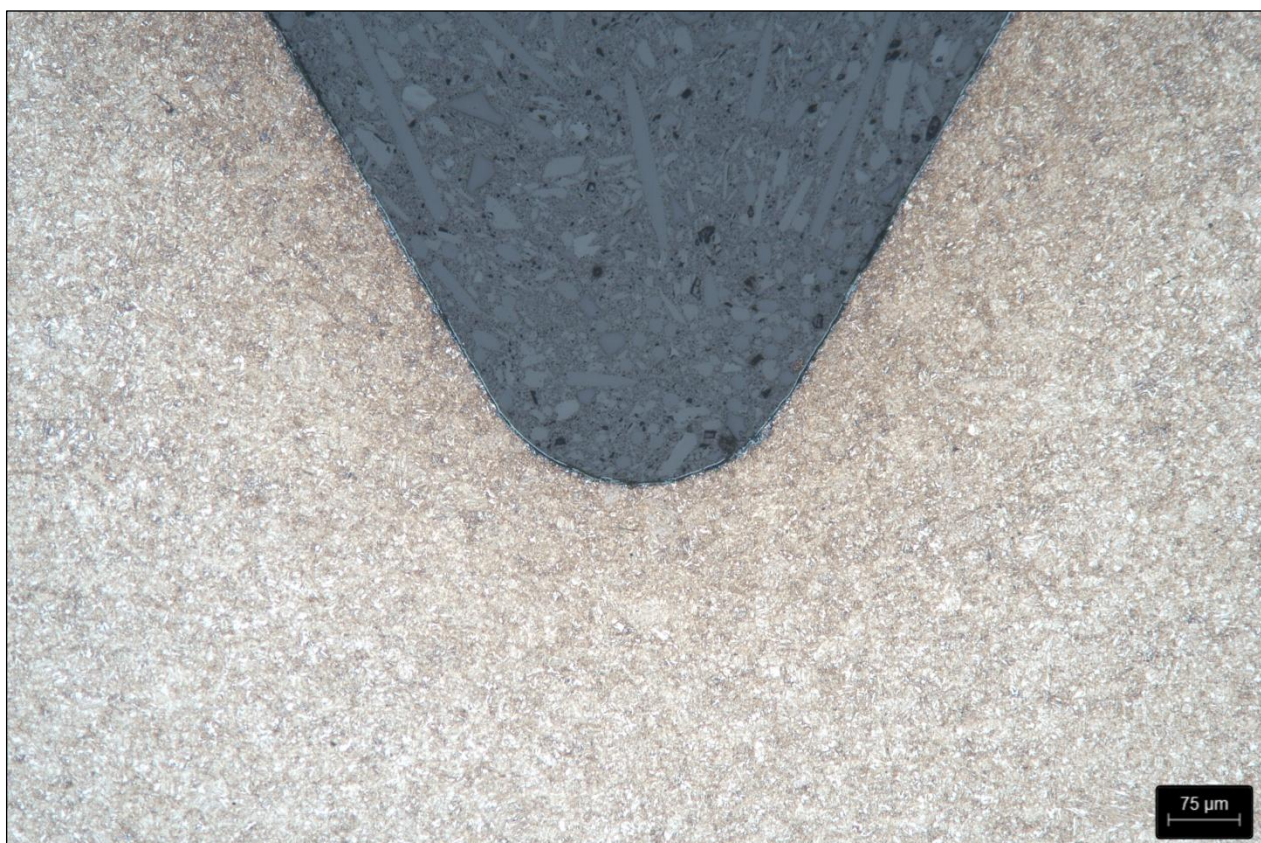


Figure 14. Root of the thread profile of sample - 100:1

## QATM-Preparation method

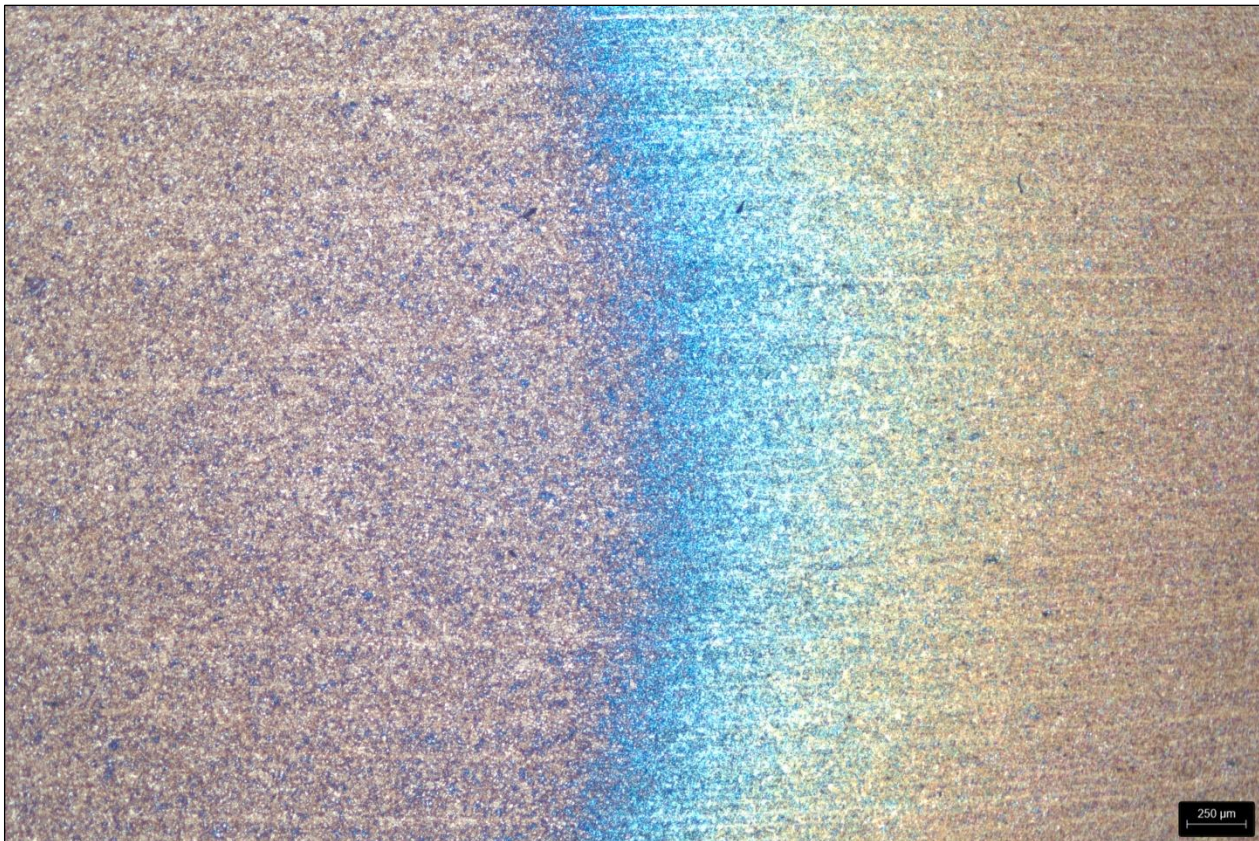


Figure 15. Overview of the transition zone in the center of sample - 25:1

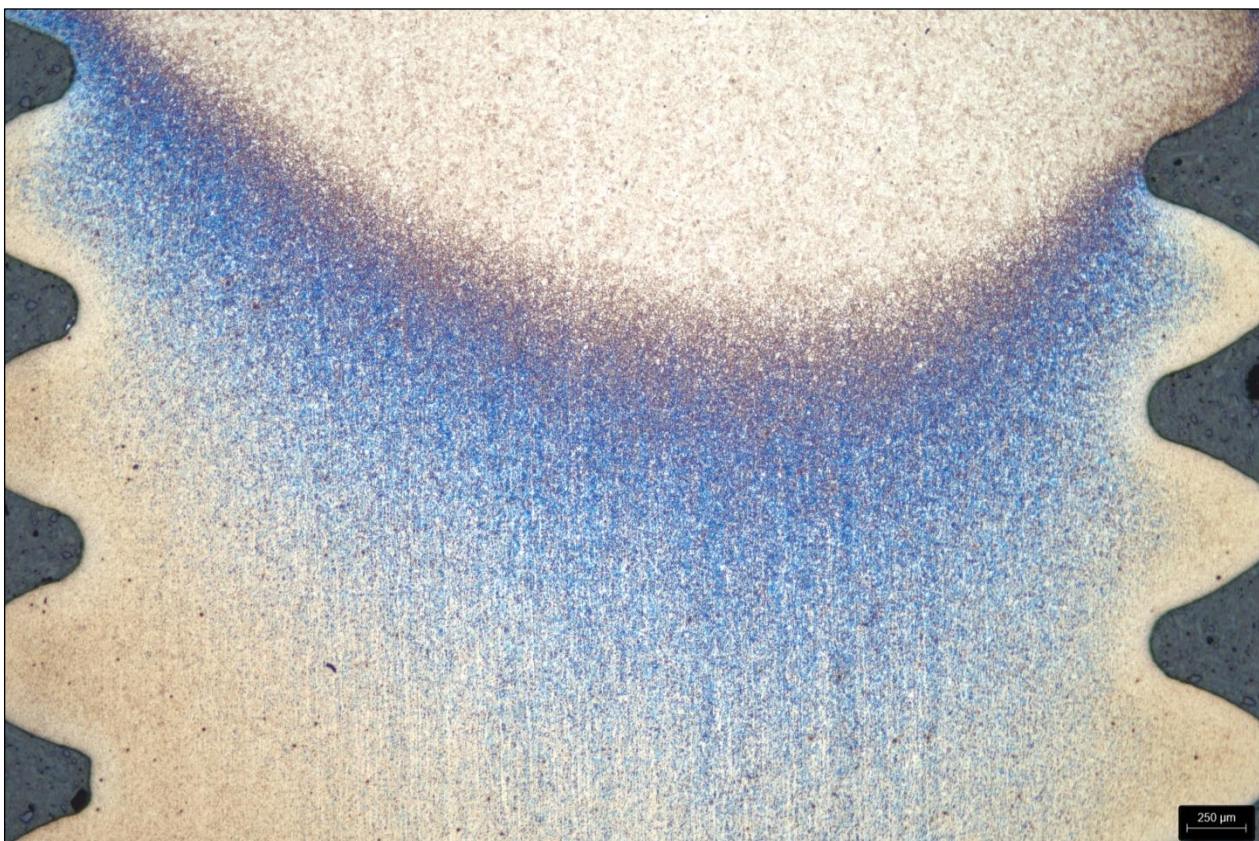


Figure 16. Overview of the thread profile and the transition zone of sample - 25:1

## QATM-Preparation method

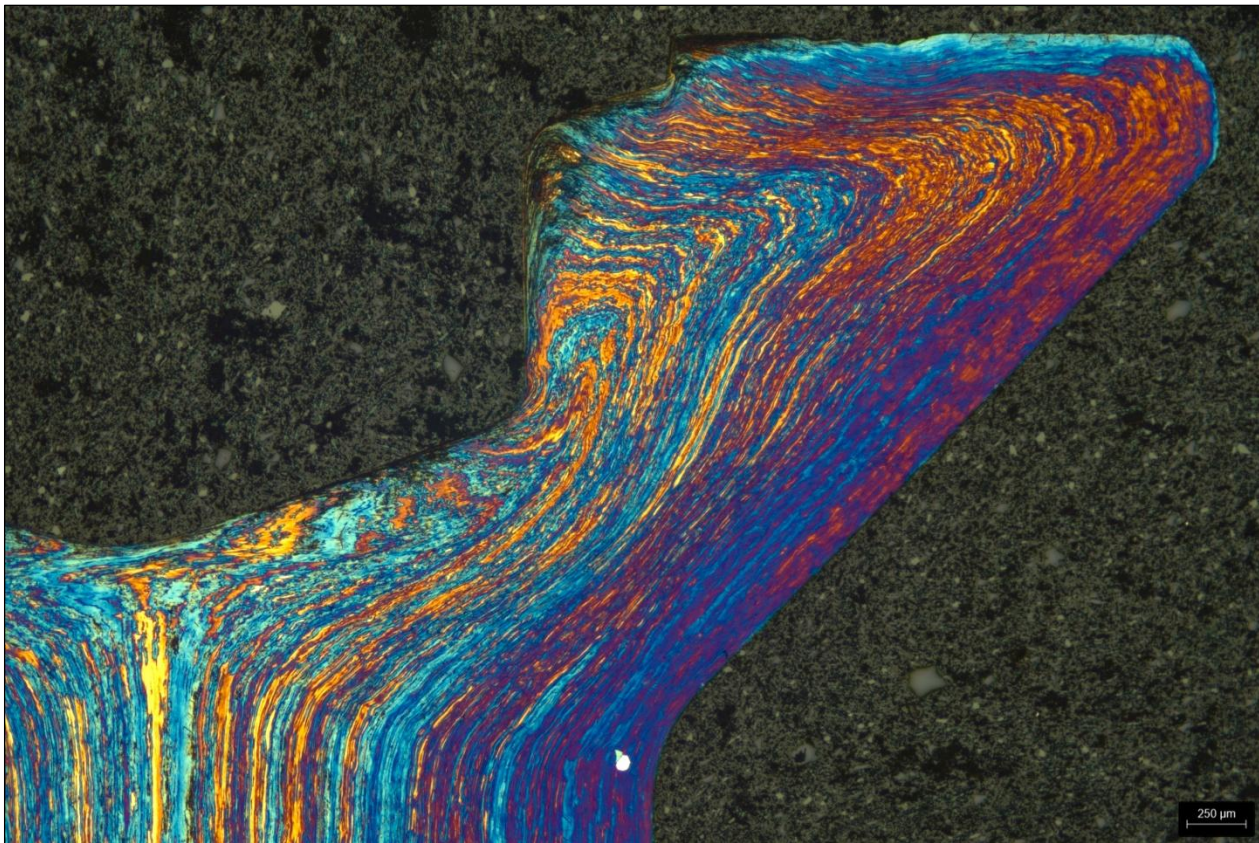


Figure 17. Head of sample etched with Beraha 2 - 25:1

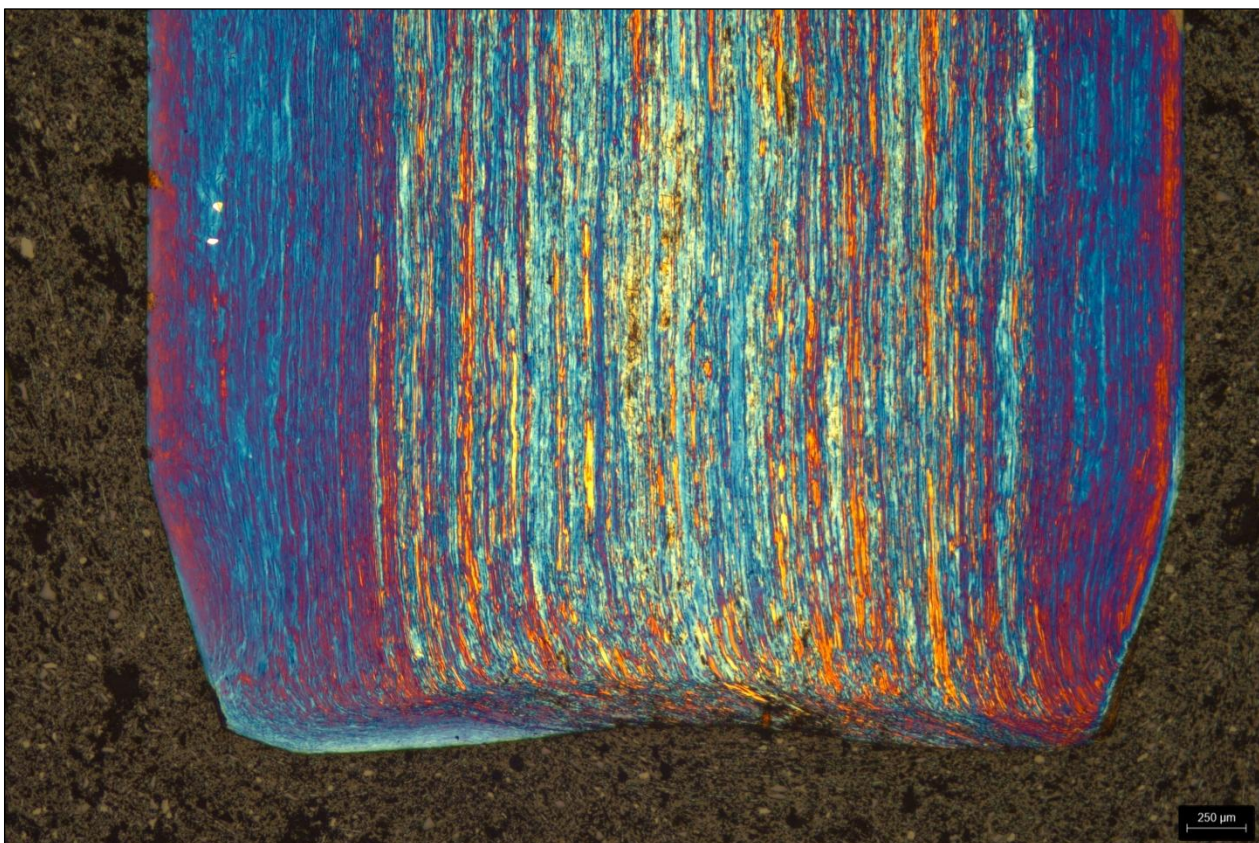


Figure 18. Shaft of sample etched with Beraha 2 - 25:1

## QATM-Preparation method

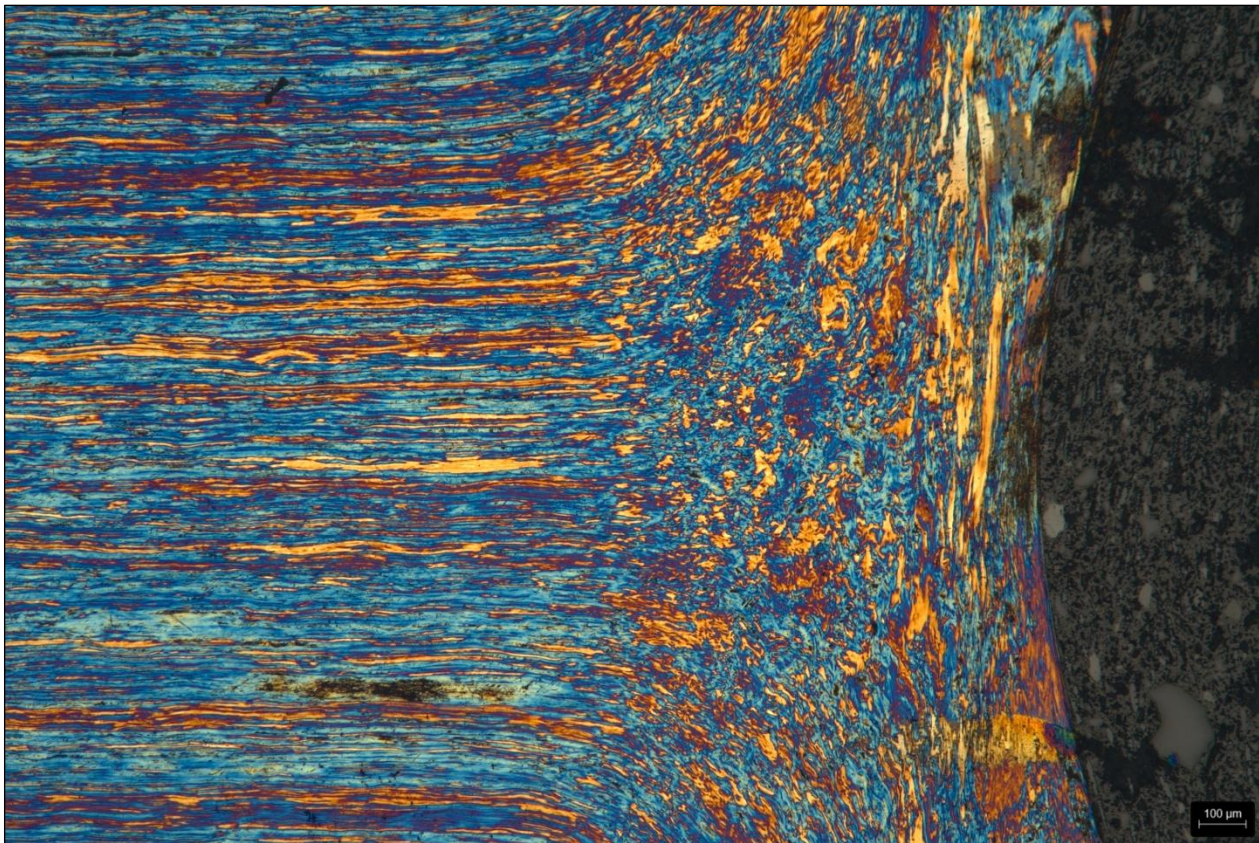


Figure 19. Microstructure of the head of sample etched with Beraha 2 - 50:1

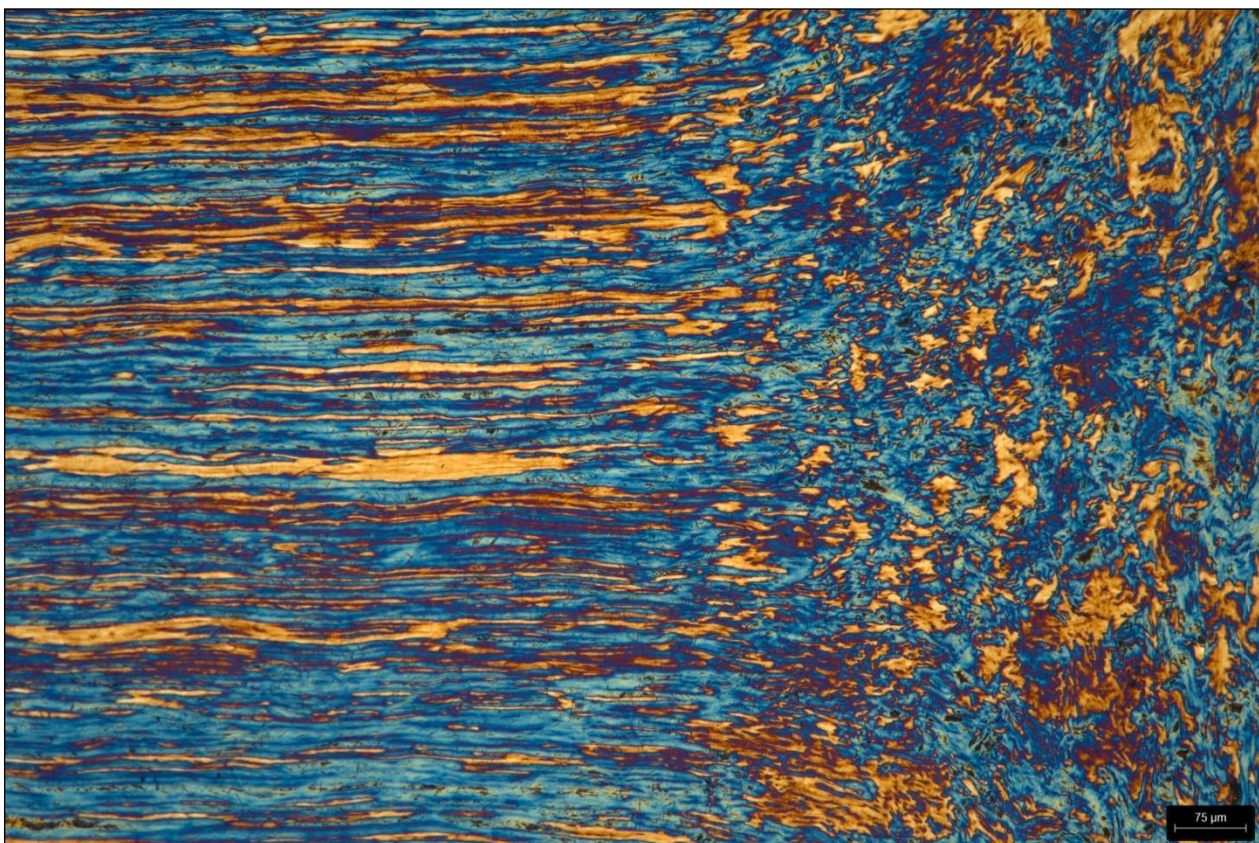


Figure 20. Microstructure of the head of sample etched with Beraha 2 - 100:1

## QATM- Preparation method

### Consumables and accessories used:

	Consumables and accessories	Article description	Item number
<b>Cutting</b>	Cut-off disc	FS-C 250	95012527
	Cut-off disc	Curundum cut-off disc	95014126
	Cutting coolant	KKS-Standard	95014281
	Filter system	Filter bag	95017308
	Shaft reduction	Shaft reduction Ø 12,7 mm	Z1822000
	Clamping tool	Qtool 40	Z2270200
	Clamping tool	Easy clamping plate S	Z2236030
	Clamping jaws	Clamping jaw slotted	Z2270203
	Clamping tool	Qtool 80 Vario	Z2231200
	Clamping jaws	Clamping jaw, cross prism	02231230
	Clamping jaws	Clamping jaw, slotted for round bar	Z2231212
	<b>Mounting</b>	Hot mounting material	Epo Black
Mounting aid		Dosing spoon	92001716
<b>Grinding</b>	Sample holder	Sample holder L	Z5446025
	Grinding disc	VEGA 54µm	95015053
<b>Polishing</b>	Fine grinding disc	Contero H	95017606
	Diamond suspension	Dia-Complete poly. 9µm	95011843
	Polishing cloth	GAMMA	95017590
	Diamond suspension	Dia-Complete poly. 3µm	95011841
	Polishing cloth	ZETA	95005778
	Diamond suspension	Dia-Complete poly. 1µm	95011840
<b>Ethching</b>	Etchant	Nitric acid 3% alcoholic	92002597

### Conclusion:

1. When cutting samples in this geometry and this hardness it is necessary to use a low feed speed, a higher feed speed would lead the cut-off disc to run sideways and result in an uneven cut. When performing the longitudinal cuts, regarding these samples we recommend positioning the cut-off disc slightly off-center in order to have one section perfectly cut in the middle. Cutting sample E. and F. using the Qcut 250 A and our premium cut-off disc FS-C ø 250mm is not possible because the disc is too thick. To make that possible we recommend a shaft reduction, which gives us the ability to use a much thinner cut-off disc in ø 200mm. It is possible to cut all sent screws using the Qcut 250 A.
2. Grinding and polishing the samples sent is possible in just four steps. Planar grinding on our Vega diamond grinding disc is the best option for this application, because it delivers high removal in combination with a long lifetime. To minimize rounding of the edges of the samples we recommend using our fine-grinding disc Contero H for the 9µm-step and our hard polishing cloth GAMMA for the 3µm-step. We suggest cleaning the samples only with ethanol to avoid corrosion on the surface. While preparing sample A. (zinc-coated) we focused on the microstructure, and worked with water-based diamond suspensions, which caused damage to the zinc-layer. If you want to analyze the zinc-layer, using alcohol-based diamond suspensions will deliver a much better condition.