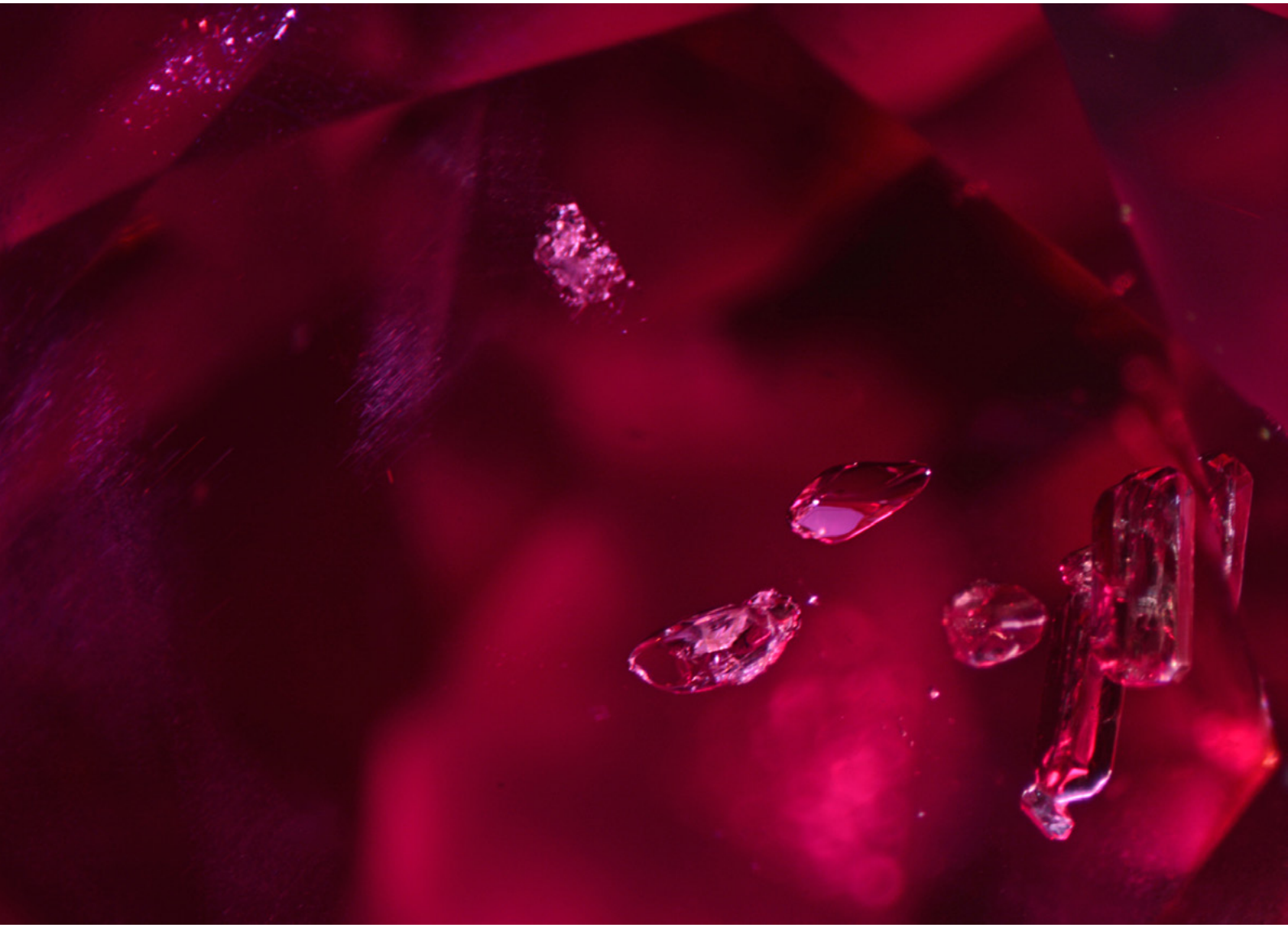
Application Note



ZEISS Stemi 508

Stereomicroscopic Investigation of Gemstones

ZEISS Stemi 508

Stereomicroscopic Investigation of Gemstones

Authors: Dr. Michael S. Krzemnicki
Swiss Gemological Institute SSEF

Manfred Eickhorst
System Eickhorst, Germany

Dr. Thorsten Kern
Carl Zeiss Microscopy GmbH, Germany

Date: May 2018

Use of microscopes is an essential step in order to distinguish fake gemstones from real gemstones and assess the quality of the stones. Inclusions, artificial growth patterns, and scratches can be visualized especially well using darkfield illumination.

Introduction

Colored gemstones are crystalline, inorganic natural materials. Depending on the deposit and locality, and the associated geological stone environment, the microscopic inclusions of accessory minerals vary in a natural gemstone. Determining these inclusions is of great importance in evaluating the stones – regardless of the degree of processing. Stereo microscopes are used to characterize gemstones such as sapphire (blue), emerald (green), and ruby (red). In addition to visual inspection, the determination analysis of gemstones comprises other analytical methods such as Raman spectroscopy, X-ray tomography, UV-VIS absorption, or GemTOF.

Recommended Microscope Equipment

Greenough stereo microscopes have become the established tools for achieving as precise as possible an interpretation of the mineral inclusions in gemstones. A Greenough-type stereo microscope (Figure 1) utilizes long working distances for easy specimen handling and large fields of view. It is compact, robust, user-friendly, and low-maintenance. The relevant particle size of the mineral inclusions is also suitable for stereomicroscopic evaluation.

ZEISS Stemi 508 is a Greenough stereo microscope with an apochromatic beam path. The apochromatic zoom optics and efficient stray light suppression give you a crisp three-dimensional image, distortion-free, without color fringes. The large 8:1 zoom provides high-contrast images of minuscule crystalline or amorphous inclusions. Select from a range of apochromatic front optics and eyepieces to achieve any magnification between 2× and 250×. Using optional 16× eyepieces, Stemi 508 covers a magnification range from 10× to 80× – an extraordinary spectrum in the field of gemology. Digital microscope cameras are available to document the examined stones. Cameras should have good dynamics and a pixel count that is appropriate for the optics (ZEISS Axiocam 305 recommended). DSLR adaptation is also employed in practice for additional macro photography.

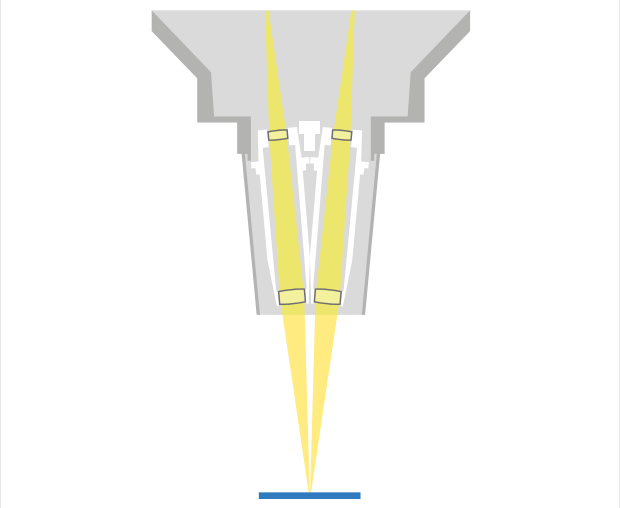


Figure 1 *Beam path of a Greenough-type stereo microscope*

Gemologists generally use darkfield illumination to determine inclusions. By focusing special LEDs in the gemstone to be examined, the inclusions in the stone light up; this excitation light goes past the observing beam path, however. The observing optics of the stereo microscope only collect the scattered light from the sample or inclusions in front of a black background. The resulting images are high in contrast and color fidelity. There is, of course, also the option of integrating mixed light with spotlights or transmitted illumination on a GEMMASTER® stand.

LED versus Halogen Illumination

The advantage of focused LED lighting compared to halogen illumination is that the total intensity of the light source is concentrated to a point on the gemstone. Bright inclusions are displayed in high contrast and stand out well in front of the dark background. GEMMASTER (Figure 2) provides the option of switching to a brightfield for transmitted light mode and examinations in incident light with a focused LED.

Figure 2 *GEMMASTER is an ergonomic, tilted base equipped with focused LED lighting. ZEISS Stemi 508 provides the observation optics and captures the scattered light.*

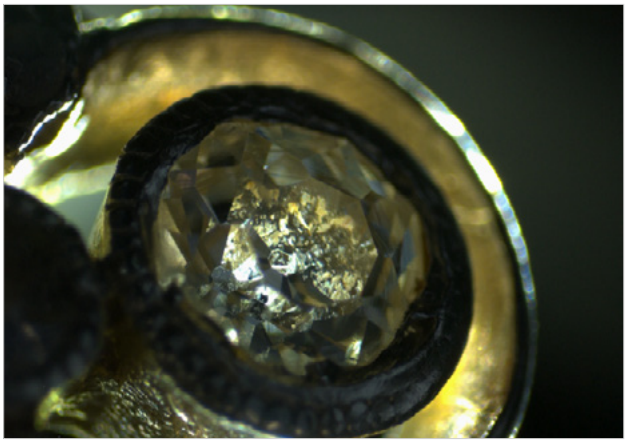


Figure 3 *An "old cut" diamond set in a piece of jewelry. The illuminating light is focused on the stone, passing through the bottom opening of the setting and revealing the typical cut edges of the processed stone.*

Summary

As an integral part of an overall analytical process, stereomicroscopic studies of colored gemstones provide an important contribution to qualitative analysis. Suitable accessories like GEMMASTER darkfield base allow for optimal visualization and analysis of the inclusions.

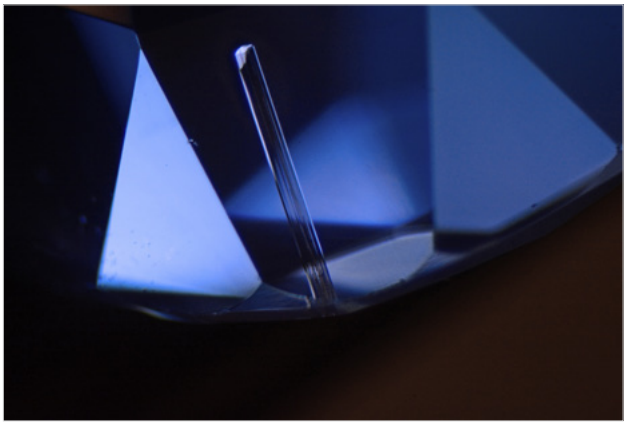


Figure 4 *Prismatic green hornblende inclusion (amphibole) in sapphire from Kashmir, India. The inclusion was identified using Raman microspectroscopy. These types of green hornblende needles are a characteristic inclusion in sapphire from India and allow experienced gemologists to determine the origin of the cut sapphire in a piece of jewelry. GEMMASTER with ZEISS Stemi 508; darkfield illumination, magnification: 50×*
Courtesy of the Swiss Gemological Institute SSEF

Figure 5 *The two round atoll-like explosive fractures coming from a natural healing crack with a number of tube-shaped liquid inclusions prove that the orange sapphire being examined was heated. Adamantine spar (ruby and sapphire) is frequently heated to improve its color and transparency. For this reason, it is important with adamantine spar to always check whether it is untreated or has been heated. This factor significantly impacts the price of the gemstone.*
GEMMASTER with ZEISS Stemi 508; darkfield illumination, magnification: 50×
Used with the generous permission of the Swiss Gemological Institute SSEF

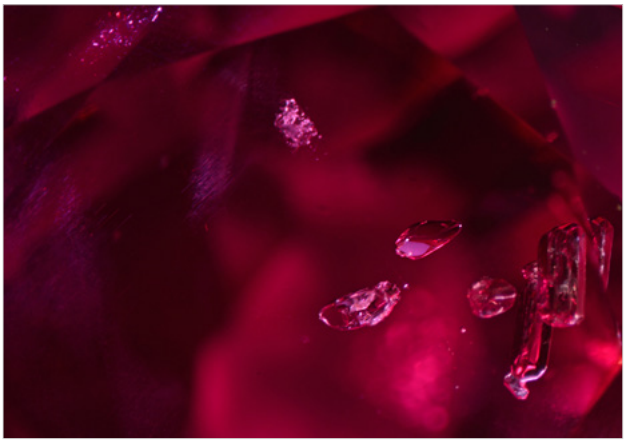


Figure 6 *Typical image of inclusions in a Burmese ruby with colorless prismatic amphibolic crystals, warped spinel octahedrons, and finely distributed rutile needles, identified using Raman microspectroscopy.*
Rubies, especially those from Mogok in Burma, Myanmar, almost always contain inclusions. These inclusions not only tell gemologists where the stone came from geographically and in what conditions it was formed, but also lend the stone an individual beauty as long as they do not significantly influence the color and purity of the stone.
GEMMASTER with ZEISS Stemi 508; darkfield illumination, magnification: 30×
Courtesy of the Swiss Gemological Institute SSEF

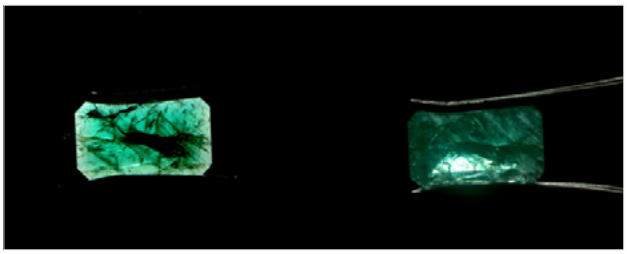


Figure 7 *Synthetic emerald (Chatham), observed with and without an immersion medium in polarized transmitted light. Using an immersion medium with a refraction index similar to that of the precious stone minimizes surface reflections and makes the internal structure of the stone visible.*

References:

[1] Alan Hodgkinson, Gemtesting Techniques, 2015 self-published; printed in Scotland by J. Thomson Color Printers.

[2] Ruby and Sapphire, "A gemologist's guide," Richard W. Hughes et al., 2016; Lotus Verlag

[3] "Facette," annual publication of Swiss Gemological Institute SSEF, #23/2017 ISSN: 2296-214X

Footnotes:

[1] A diamond is flawless when no inclusions can be detected with 10× magnification.

[2] The deposit produces qualities and quantities, as well as features of origin, which are decisive factors for gemologists and precious stone traders. Rubies from Burma, Myanmar, for example, often command a significantly higher price than the same variety of stone from Africa (e.g. Kenya) or other places. Prices may be ten times higher.

Carl Zeiss Microscopy GmbH
07745 Jena, Germany
microscopy@zeiss.com
www.zeiss.com/stemi508