nucleohyaloplasm. Cytosol also surrounds the **cytoskeleton**; the **cytosol** is a "soup" with free-floating particles, but it is highly organized on the molecular level (compare to **cytoplasm**, which also includes the organelles).

Dale–Gladstone law: One of the **refractive index** mixture rules stating that the mean value of **refractive index** $\bar{n}$ of a composition represents an average of the refractive indices of its noninteracting components related to their **volume fractions**. n_i and f_i are the **refractive index** and **volume fraction** of the individual components, respectively, and N is the number of components when volume additivity is assumed, i.e., $\sum_i f_i = 1$.

$$\bar{n} = \sum_{i=1}^{N} n_i f_i$$

dalton (Da):   Unit of mass used to express atomic and molecular masses. Also, it is the approximate mass of a hydrogen atom, a proton, or a neutron. The atomic mass unit is one-twelfth of the mass of an isolated atom of carbon-12 (^{12}C) at rest and in its ground state. In biochemistry and molecular biology the term **dalton** is referenced with the symbol Da. The **Avogadro constant** (N_A) and the **mole** are defined so that one **mole** (1 mol) of a substance with atomic or molecular mass of 1 Da will have a mass of precisely 1 g, thus 1 Da = 1 g/mol (for isotopically pure substances). Because **proteins** are large molecules, their masses are often in kilodaltons, where one kilodalton is 1000 Da. The unified atomic mass unit, or **dalton**, is not an SI unit of mass, but it is accepted for use with SI. The one-to-one relationship between **daltons** and g/mol is true, but to be used accurately for practical purposes, any calculations must be with isotopically pure substances or involve much more complicated statistical averaging of multiple isotopic compositions.

dark noise: An accumulation of heat-generated electrons in the **photodetector** with no incident **light**. In **charge-coupled-device (CCD) sensors** these electrons end up in the photosites and

contribute a snowlike appearance to the image. A related concept, dark current, refers to the rate of generation of these electrons, most of which come from boundaries between silicon and silicon dioxide in the **charge-coupled-device (CCD) sensor**.

dark-field illumination: Used in dark-field **microscopy** for imaging of optically transparent nonabsorbing specimens, where illuminating **light** does not enter into the ocular and only **light** scattered by microparticles of the specimen creates the image. In the **field of view** of the microscope on the dark background, bright images of the specimen particles (which differ by their **refractive index** from the surrounding medium) are seen.

dark-field photoacoustic microscopy (PAM):   Special system that uses a pulsed **laser beam** delivered by a **multimode optical fiber** passed through a conical **lens** to form a ring-shaped illumination. This is weakly focused into biological **tissues**, where the optical focus coaxially overlaps with the ultrasonic focus. The **dark-field illumination** is combined with the acousto-optical confocal configuration. The **laser**-pulse **energy** deposited into the **tissue** is partially absorbed and converted into heat, which induces a local **pressure** rise via transient thermoelastic expansion. The **pressure** rise travels through the **tissue** in the form of a wideband ultrasonic **wave** referred to as a **photoacoustic wave**, and it is detected by an **ultrasonic transducer**. The system provides a high **signal-to-noise ratio (SNR)** because the **photoacoustic** signal in the detectable surface area is greatly minimized.

DC measurements: Measurements done using direct current (DC) electronics.

decibel (dB):   The engineering unit for the ratio of the input **power** P_{in}, in a given device to the output **power** P_{out}. It is convenient to measure the logarithm of the ratio log (P_{out}/P_{in}), and the decibel is a standard unit that is equal to 10 times that log: 10 log (P_{out}/P_{in}) **dB**.

deconvolution microscopy: Microscopy technique based on the knowledge of the point-spread function of the microscope-imaging system and its reversing by computer-based methods using various 2D or 3D **algorithms**. This can be an advantage over other types of 3D **microscopy** such as **confocal microscopy**, because **light** is not thrown away but reused. For 3D deconvolution, one typically provides a series of images derived from different **focal planes** (called a Z-stack) plus the knowledge of the point-spread function, which can be either derived experimentally or theoretically from knowing all contributing parameters of the microscope.

decorrelation of speckle: Relates to statistics of the second order that characterize the size and distribution of **speckle** sizes and show how fast the **intensity** changes from point to point in the **speckle** pattern: decorrelation means that such changes of **intensity** tend to be faster.

decylmethylsulfoxide: N-decylmethylsulfoxide (nDMSO) is a **tissue**-penetrating agent, such as **dimethyl sulfoxide**.

deep random-phase screen (RPS): A random-phase screen that induces phase fluctuations in a scattered field with a **variance** that is much more than unity.

deflectometry: A **photorefractive technique** based on detection of refractive-index gradients above and inside the sample using a **laser probe** beam.

deformation: In biomechanics, **deformation** is a change in shape due to an applied force. It can be a result of tensile (pulling) forces, compressive (pushing) forces, shear, **bending**, or torsion (twisting). **Deformation** is often described in terms of strain.

degree of circular polarization (DOCP): From the **Stokes vector**, the **DOCP** is derived as DOCP $= \sqrt{V^2}/I$. See **light polarization**, **degree of polarization (DOP)**, and **Stokes parameters**.

degree of linear polarization (DOLP): From the **Stokes vector,** the **DOLP** is derived as DOLP = $\sqrt{Q^2 + U^2}/I$ or experimentally $P_L = (I_{\parallel} - I_{\perp})/(I_{\parallel} + I_{\perp})$, where $I_{\parallel}$ and $I_{\perp}$ are the **intensity** of **light** polarized in parallel and perpendicular to **polarization** plane, respectively. See **light polarization**, **degree of polarization (DOP)**, and **Stokes parameters**.

degree of polarization (DOP): The ratio of the **intensity** of **polarized light** to the total **intensity** of **light**. From the **Stokes vector**, the **DOP** is derived as DOP = $\sqrt{Q^2 + U^2 + V^2}/I$. If the DOP of a light field remains at unity after transformation by an optical system, this system is nondepolarizing; otherwise, the system is depolarizing. See **light polarization**, **Stokes parameters**, **depolarization**, **and depolarization length**.

dehydration: Removal or loss of **water** by a **tissue** or a **cell**. It may be induced by heating or by action of **hyperosmotic** agents.

deionized water (DIW) (*Synonym*: demineralized water): **Water** that has had its mineral ions removed—such as cations from sodium, calcium, iron, and copper, and anions such as chloride and bromide. Deionization is a physical process that uses specially manufactured ion-exchange resins that bind to and filter out the mineral salts from **water**. Because the majority of **water** impurities are dissolved salts, deionization produces high-purity **water** that is generally similar to **distilled water**, and the process is quick and low cost. However, deionization does not significantly remove uncharged organic molecules, **viruses**, or **bacteria**, nor does it remove the hydroxide or hydronium ions from **water**, because these are the products of the self-ionization of **water** to equilibrium and therefore impossible to remove. Only specially made strong-base anion resins can remove **Gram-negative bacteria**. Deionization can be done continuously and inexpensively using electrodeionization.

delay generator (DG): An electronic device that is used in many types of experiments, controls, and processes where electronic

timing of a single event or multiple events using a common timing reference is needed. The delay generator may initiate a sequence of events or be triggered by an event. The digital-delay generator differs from ordinary electronic timing because of the high synchronicity of its outputs to each other and to the initiating event.

delta (δ)-aminolevulinic acid (ALA) (*Synonym*: 5-aminolevulinic acid): A prodrug that leads to the **endogenous** synthesis of **protoporphyrin IX** in the **cells** and **tissues** when applied either systematically or topically. **Photodynamic therapy** drugs, such as Levulan®, Metvix®, Alasens®, and **Hexvix®**, are efficient for the treatment of actinic keratoses, **squamous-cell carcinomas**, and basal-**cell carcinomas**. With **photodynamic therapy**, a typical irradiation **wavelength** is 630–635 nm with the typical **laser** dose of 150 J/cm^2.

delta (δ)-Eddington approximation: A simple yet accurate method that was proposed for determining monochromatic radiative fluxes in an absorbing–**scattering** atmosphere. In this method the governing **phase function** is approximated by a Dirac delta function forward-scatter peak and a two-term expansion of the **phase function**. The fraction of **scattering** into the truncated forward peak is taken proportional to the square of the phase-function asymmetry factor, which distinguishes the delta-Eddington approximation from others of similar nature. It is one of the approximations of the actual **phase function** for **tissue**. In the **diffusion approximation** of **radiation-transfer theory**, it is the best function for simulating **light** transport in **tissues** characterized by an **isotropic scattering**.

delta *T* (Δ*T*): The temperature difference between two targets, usually comparable targets under comparable conditions.

demineralization: Loss of mineral from mineralized **tissues**. In **tooth tissue**, **demineralization** may lead to **caries**. In **bone tissue**, **demineralization** causes **osteoporosis**. **Bacteria** in

tooth plaque use simple **carbohydrates** such as **sucrose** and **glucose** in our diet for their metabolic needs and produce **lactic acid**. During the breakdown of these substrates, this acid can demineralize the **tooth**. **Demineralization** of outermost **tooth** layers, **enamel** and **cementum**, is the starting point of **tooth** destruction. Small amounts of **tooth demineralization** occur daily; **remineralization** can occur as mineral is replaced with calcium and phosphate from **saliva**.

demineralized water: See **deionized water (DIW)**.

demodulation: The separation and extraction of modulating low-**frequency** waves from a modulated carrier **wave** (high-**frequency** or optical **wave**). The device or circuit used for **demodulation** is called a detector or demodulator.

denaturation: The alteration of a **protein** shape through some form of external stress (e.g., applying heat, acid, or alkali), in such a way that it will no longer be able to carry out its cellular function. Denatured **proteins** can exhibit a wide range of characteristics, ranging from loss of solubility to communal **aggregation**.

dendrite: Filaments that arise from the **neuron-cell** body, often extending for hundreds of microns and branching multiple times, giving rise to a complex "dendritic tree."

dendritic cell: **Immune cells** that form part of the immune system. Their main function is to process **antigen** material and present it on the surface to other **cells** of the immune system, thus functioning as **antigen**-presenting **cells**. They act as messengers between the innate and adaptive immunities. Present in small quantities in **tissues** that are in contact with the external environment, mainly the **skin** (where there is a specialized dendritic **cell** type called Langerhans **cells**) and the inner lining of the nose, **lungs**, **stomach**, and **intestines**. It is also found in an immature state in the **blood**. Once activated, they migrate to the **lymph node** where they interact with T and B