Claims

1. A multifocal lens having several concentric diffractive zones on a surface of the lens, wherein in each diffractive zone (7, 8, 9, 10) a diffraction phase structure is defined, which is expressible by the following piecewise function, which comprises three phase terms, or by a smoothed version of the following piecewise function:

$$\phi(\xi) = 2\pi \times \begin{cases} p_1\xi, & 0 \leq \xi < w_1 \\ p_2\xi + q_2, & w_1 \leq \xi < w_2 \\ p_3\xi + q_3, & w_2 \leq \xi < 1 \end{cases} ,$$

wherein ξ indicates a position within the respective diffractive zone (7, 8, 9, 10) in a radial direction, $\phi(\xi)$ indicates a phase shift experienced by light passing through the position indicated by ξ, w_1 and w_2 define a spatial partitioning of the respective diffractive zone (7, 8, 9, 10) in the radial direction in accordance with the three phase terms, p_1, p_2 and p_3 indicate gradients of the three phase terms and q_2 and q_3 are constants, wherein ξ depends quadratically on a radial distance to the center of the surface (2) of the lens (1) and is normalized with respect to the radial width of the respective diffractive zone (7, 8, 9, 10) and wherein the gradients p_1, p_2 and p_3 are negative, wherein a) the gradient p_1 is within a range from -1.1 to -1.0, the gradient p_2 is within a range from -1.1 to -1.0, the gradient p_3 is within a range from -1.1 to -1.0, the constant q_2 is within a range from 0.3 to 0.4 and the constant q_3 is within a range from 1.0 to 1.1, or b) the gradient p_1 is within a range from -1.2 to -1.0, the gradient p_2 is within a range from -1.3 to -1.2, the gradient p_3 is within a range from -1.2 to -1.0, the constant q_2 is within a range from 0.7 to 0.8 and the constant q_3 is within a range from 1.0 to 1.2, or c) the gradient p_1 is within a range from -1.2 to -0.4, the gradient p_2 is within a range from -1.0 to -0.1, the gradient p_3 is within a range from -1.2 to -0.4, the constant q_2 is within a range from -0.2 to 0.3 and the constant q_3 is within a range from 0.4 to 1.2.

2. The multifocal lens as defined by claim 1, wherein the lens (1) is a trifocal lens with diffractive orders 0, +1 and +2.

3. The multifocal lens as defined by any of claims 1 and 2, wherein the constants q_2 and q_3 are positive.

4. The multifocal lens as defined by any of the preceding claims, wherein the constant w_1 is 0.25 and the constant w_2 is 0.75 such that the radial width of the middle phase term is twice the radial width of the inner phase term.

5. The multifocal lens as defined by any of the preceding claims, wherein the smoothed version of the function $\phi(\xi)$ is obtained by convoluting the function $\phi(\xi)$ with a Gaussian kernel, wherein the Gaussian kernel has a standard deviation within a range from 0.02 to 0.04.

6. The multifocal lens as defined by any of the preceding claims, wherein the outer border (11) of at least the innermost diffractive zone (7) is defined by

$$r_k = \sqrt{\frac{2\lambda k}{p} + k^2\lambda^2} \quad ,$$

wherein k indicates the respective diffractive zone, λ is the wavelength of the light and p is a predefined value defining an add power.

7. The multifocal lens as defined by claim 6, wherein the equation of claim 6 defines the outer border of the innermost diffractive zone (7) and the outer border of the other diffractive zones (8, 9, 10) is defined by

$$r_k = \left({r_{k-1}}^2 + \lambda^2 + \sqrt{\frac{4\lambda^2}{p^2} + 4\lambda^2 {r_{k-1}}^2} \right)^{1/2} \quad .$$

8. The multifocal lens as defined by any of the preceding claims, wherein the constants w_1 and w_2 are the same for all diffractive zones (7, 8, 9, 10).

9. The multifocal lens as defined by any of the preceding claims, wherein the gradients p_1, p_2 and p_3, and the constants q_2 and q_3 are the same for all diffractive zones (7, 8, 9, 10).

10. The multifocal lens as defined by any of claims 1 to 8, wherein the gradients p_1, p_2 and p_3, and the constants q_2 and q_3 are not the same for all diffractive zones (7, 8, 9, 10).

11. The multifocal lens as defined by any of claims 1 to 8, wherein the gradients p_1, p_2 and p_3, and the constants q_2 and q_3 are different for all diffractive zones (7, 8, 9, 10).

12. A method for producing a multifocal lens having several concentric diffractive zones on a surface of the lens, wherein the method includes:

- mathematically providing a diffraction phase structure for each diffractive zone (7, 8, 9, 10) by providing for each diffractive zone (7, 8, 9, 10) following piecewise function, which comprises three phase terms, or a smoothed version of the following piecewise function:

$$\phi(\xi) = 2\pi \times \begin{cases} p_1\xi, & 0 \le \xi < w_1 \\ p_2\xi + q_2, & w_1 \le \xi < w_2 \\ p_3\xi + q_3, & w_2 \le \xi < 1 \end{cases} \quad ,$$

wherein ξ indicates a position within the respective diffractive zone (7, 8, 9, 10) in a radial direction, $\phi(\xi)$ indicates a phase shift experienced by light passing through the position indicated by

ξ, w_1 and w_2 define a spatial partitioning of the respective diffractive zone (7, 8, 9, 10) in the radial direction in accordance with the three phase terms, p_1, p_2 and p_3 indicate gradients of the three phase terms and q_2 and q_3 are constants, wherein ξ depends quadratically on a radial distance to the center of the surface (2) of the lens (1) and is normalized with respect to the radial width of the respective diffractive zone (7, 8, 9, 10) and wherein the gradients p_1, p_2 and p_3 are negative, wherein a) the gradient p_1 is within a range from -1.1 to -1.0, the gradient p_2 is within a range from -1.1 to -1.0, the gradient p_3 is within a range from -1.1 to -1.0, the constant q_2 is within a range from 0.3 to 0.4 and the constant q_3 is within a range from 1.0 to 1.1, or b) the gradient p_1 is within a range from -1.2 to -1.0, the gradient p_2 is within a range from -1.3 to -1.2, the gradient p_3 is within a range from -1.2 to -1.0, the constant q_2 is within a range from 0.7 to 0.8 and the constant q_3 is within a range from 1.0 to 1.2, or c) the gradient p_1 is within a range from -1.2 to -0.4, the gradient p_2 is within a range from -1.0 to -0.1, the gradient p_3 is within a range from -1.2 to -0.4, the constant q_2 is within a range from -0.2 to 0.3 and the constant q_3 is within a range from 0.4 to 1.2,

- forming the diffractive multifocal lens (1) such that the diffractive zones (7, 8, 9, 10) have the mathematically provided diffraction phase structures.