or to have varying sized gaps in between. Preferably the individual micro-objectives **210** are relatively close to one another making approximately 91% of a plane of the array **200** contained within the touching or almost touching micro-objectives **210**. The 91% figure is given more precisely as $\pi/2\sqrt{3}$, the ratio of the area of a circle to its circumscribed hexagon. The x-rays falling within this fraction will be imaged by each individual micro-objective or Fresnel Zone Plate **210**.

It should be appreciated that any suitable array pattern may be selected which will form an image from the incoming x-rays **110**. Preferably, multiple micro-objectives **210** are used, each forming one image per micro-objective. In a preferred example, the micro-objectives **210** are arranged in a circular pattern, as illustrated in FIG. **4**B. In this embodiment, the individual micro-objectives are situated in a pattern adapted to receive and image a ring field emission pattern of the incoming x-rays **110**, such as can be generated with a cylindrical collector x-ray mirror **60**, that generally produces a ring field of illumination. Other array shapes may also be selected to optimally receive and image the x-rays **110**. Likewise, a single micro-objective may be used, but an array with multiple micro-objectives is preferred as a view is captured by each micro objective or zone plate in the array **200** thereby increasing the total x-ray radiation collected by the imaging system, and also reducing the number of times the sample needs to be moved and the system realigned to produce an image, reducing the total time to acquire an image.

In an illustrative example, zone plates are used in the composite objective **120** and an order order-sorting aperture **140** is used in order to refine the image. To separate the first-order diffracted x-rays (which are the imaging x-rays) from the zero-order diffracted x-rays (which are non-imaging), a central stop **220** is introduced into the zone plate, as illustrated in FIG. **6**. In one example, a sample radius is r, the zone plate radius is R, and the radius of the central stop be R_o. In this example, the sample radius r is half the length of the largest two-dimensional distance in the object plane between any two points in the sample **80** that are illuminated by x-rays. For a single zone plate to avoid overlap between the zero and first orders, the following relationship holds:

$$2r \leq \left(1 + \frac{1}{M}\right)R_0,$$

where M is the unsigned magnification of the system, which is equal to the ratio of the distance between the image plane **161** and the zone plate (such as depicted as ZP_1 and ZP_2 in FIG. **7**, which are within composite objective **120**) and the distance between object plane (i.e. the location of sample **80**) and the zone plate (such as depicted as ZP_1 and ZP_2 in FIG. **7**, which are within composite objective **120**).

To avoid an overlap between the zero-order x-rays of one zone plate and the first-order x-rays of another zone plate, the following condition must hold, where "a" is the distance between the centers of the two zone plates:

$$2r \leq \left(1 + \frac{1}{M}\right)(a - R).$$

If the zone plates are no closer than touching, then $2R \leqq a$. Also, $R_0 < R$, as the central stop may not have a width greater than that of its zone plate. From the above equation, we can obtain:

$$2r \leq \left(1 + \frac{1}{M}\right)R_0 < \left(1 + \frac{1}{M}\right)R = \left(1 + \frac{1}{M}\right)(2R - R) \leq \left(1 + \frac{1}{M}\right)(a - R)$$

In the above example, any zone plate array having non-overlapping imaging zone plates with a central stop will not suffer from an overlap of the image formed by the first-order diffracted x-rays and the zero-order diffracted x-rays of a neighboring zone plate.

In the exemplary Fresnel zone plate **210** illustrated in FIG. **6**, there is illustrated a central stop **220** and zones **230**, **240** and **250** of the zone plate **210**.

Although it is preferred that the micro-objectives be Fresnel zone plates, as already discussed, other types of micro-objectives may also be used. For example Wolter microscopes or Kirkpatrick-Baez microscopes suitable for use with x-rays also may be used. Likewise, other types of microlenses or micromirrors also may be used as the micro-objectives **210** in the array **200**. Combinations of different types of such micro-objectives may also be used in the array **200**. Alternatively, if the imaging is done with photons, electrons, neutrons, positrons or photons or other forms of matter, other forms of suitable micro-objectives **210** may be selected which are suitable for receiving and imaging.

The preferred embodiment of the collector optic **60** includes a multilayer reflective coating with a band pass which is matched to the number of zones in each Fresnel Zone Plate **210**. The zones are illustrated in FIGS. **5** and **6** by the rings illustrated therein. The central pass frequency is matched to bright transition lines emanating from the x-ray source **10**. The role of the multilayer coating **63** is both to filter the x-ray light and to allow the collection of a larger solid angle (by a factor of about 3) than an uncoated surface.

Although a laser-based x-ray source **10**, as illustrated in FIG. **1** is preferred, a sychrotron-based x-ray source also may be used, as illustrated in FIG. **2**. In such an alternative embodiment, the array **200** may be used to improvve synchrotron-based tomography for bending magnet x-ray sources that emit less intense x-rays, but are less expensive than later generation synchrotrons, such as third generation synchrotrons. An electron beam **31** is injected from the injector **22** into the synchrotron **41**. In the case of a bending magnet, the x-rays **50** leave the synchrotron **41** in a direction tangent to the circular electron trajectory; typically these are collimated in the vertical direction but not in the horizontal direction. Using the Fresnel Zone Plate array **200**, the requirement for horizontal collimation may be relaxed by the number of zones placed in a row. This increases the amount of x-rays passing through the sample and entering the detector.

In an alternative embodiment, an x-ray tube is used, as illustrated in FIG. **3**. In typical x-ray tubes harder x-rays are typically emitted than with laser-plasma x-ray sources. Where relatively thick samples **80** are used, harder x-rays are preferred so as to increase the x-ray transmission through the specimen. As illustrated in FIG. **3**, an example of an x-ray tube includes an electron source **24** generating an electron beam **32**. The electron beam **32** impinges on a target **42** generating x-rays **50**. In embodiments where it is desired to further increase the brightness of the x-ray source, a microfocus x-ray source may be used, for example, in which the emitted x-rays **50** have a very small cross-sectional width, such as between 4 μm and 30 μm, although any dimension may be selected that provides sufficient x-ray flux for imaging the sample **80**. In one embodiment, such a relatively small x-ray source can be achieved by focusing the electron beam **32** on the target **42** by means of an electromagnetic lens.