PRINCIPLES OF GAS CHROMATOGRAPHY[1]:

Gas chromatography, GC, allows for an effective separation of components in a mixture based on the retention time of the each compound in the column used. In GC a sample is introduced into the system and flame volatilized. The sample is carried by a gaseous mobile phase (Helium, Nitrogen, Hydrogen and Argon are often used) across a silica fused capillary column, which functions as the stationary phase. Given individual components distribute themselves differently between the mobile and the stationary phase, they can be separated based on the characteristic elution time for each component.

Calibrated microsyringes are used to inject liquid samples through a silicone septum into a heated port located at the head of the column, which is customarily kept at 50° C above the boiling point of the least volatile of the sample components. Sample size for capillary columns should be in the order of 0.2 µL or less. In order to achieve these small sample sizes, sample splitter is often used to deliver a known fraction of the injected sample.

A capillary column formed in coils to fit the termostatting oven is used for the analysis. The column temperature must be controlled accurately in order to obtain satisfactory separation. Optimal temperature is dependent on the boiling point of the sample and the separation required; in general a temperature equal to the boiling point of the sample should achieve sample elution. Temperature programming allows for better control over oven temperatures and better sample separation.

A Flame Ionization Detector (FID) records the signal overtime based on the number of ions formed as sample elutes from the column; this results in a chromatogram in which each Gaussian peak corresponds to the eluted sample. The eluent from the column is directed into a air-hydrogen flame to produce ions that are pyrolyzed at the temperature of the flame. The detector register a signal by monitoring the current produced by these charged particles. A small potential is applied to the burner tip in order to move charged species toward the detector. The chromatograph obtained can be used for quantitative analysis as the intensity of each peak is proportional to the concentration of that component in the mixture.

Band- broadening and band overlap need to be minimized in order to effectively separate components of a mixture. The method of analysis can be optimized for a given mixture by altering parameters such as the oven temperature, the flow rate, split ratio etc…

[1] D.A. Skoog, F.J.Holler, S.R. Crouch; Principles of Instumental Analysis 6th ed.; Belmont, CA: Thomson Higher Ed., 2007.